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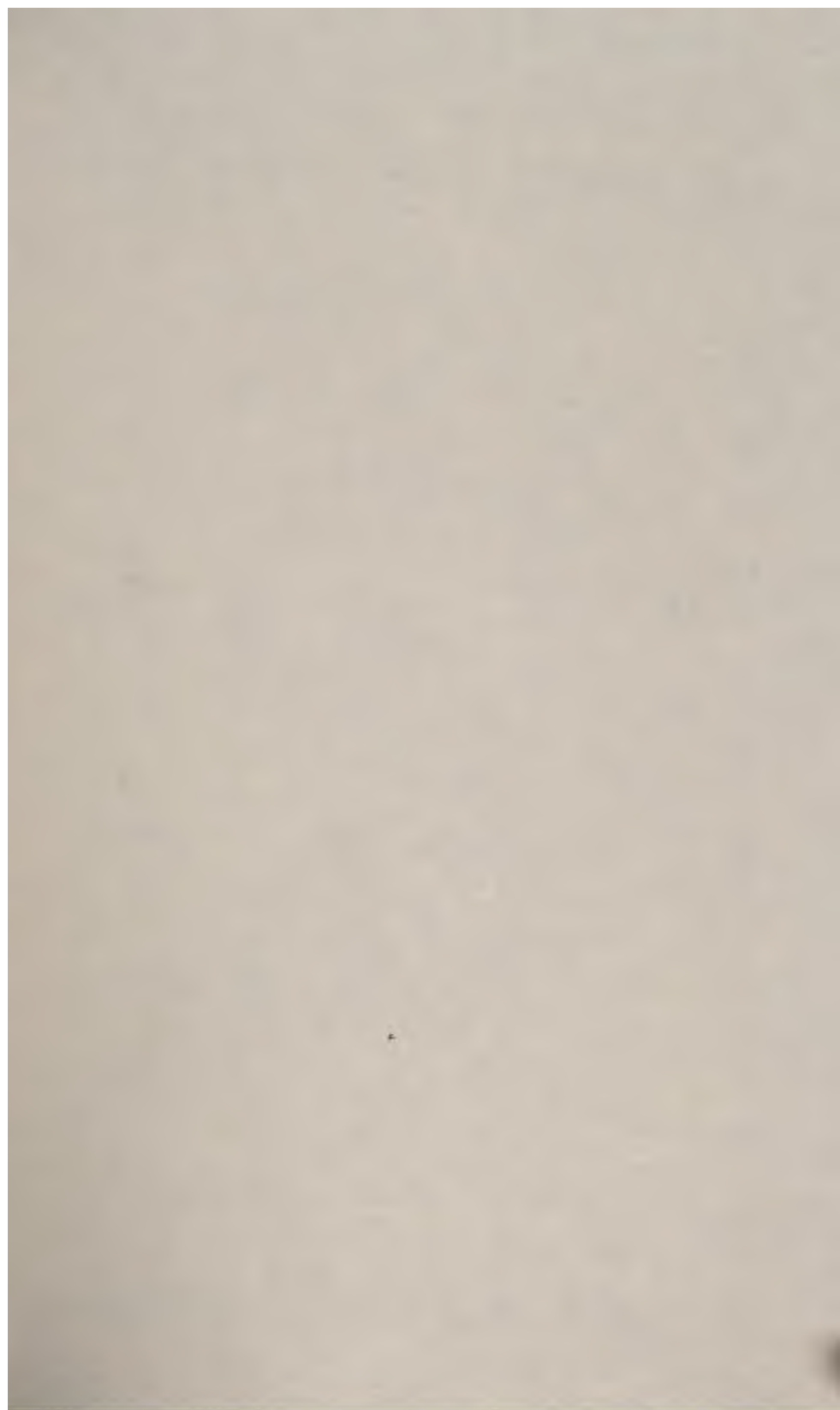
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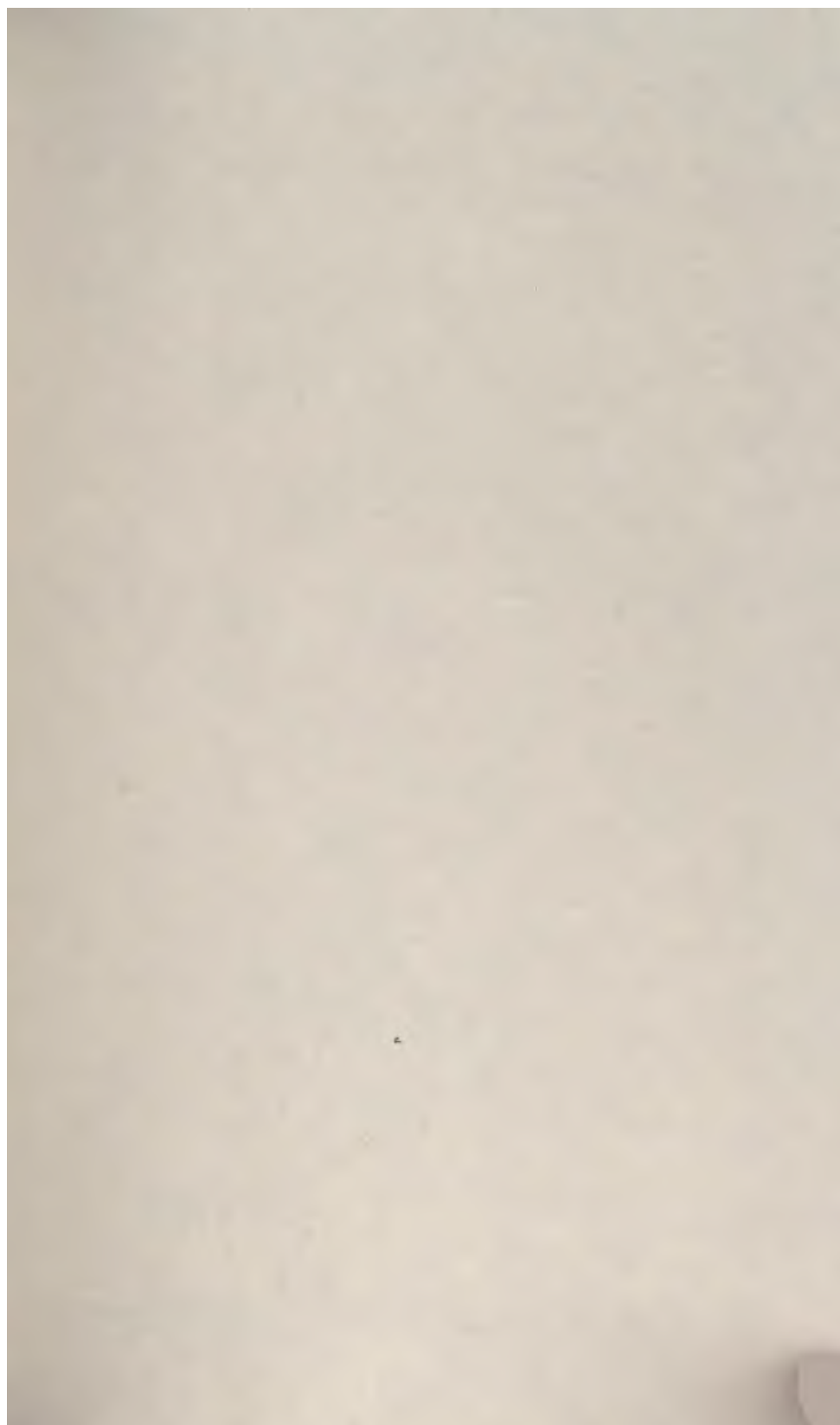












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VOLUME XVI.



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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

**THE PROTECTION OF THE HULLS OF VESSELS
BY LACQUER.**

BY LIEUTENANT J. B. MURDOCK, U. S. N.

Among the many problems arising from the use of steel in naval construction, none is more important than that of protecting the under-water body of a vessel from the corrosive action of sea-water. The problem is a modification of the old one of protecting the bottoms of wooden or iron vessels, as steel is much more liable to corrosion under water than iron, and steel vessels, being generally constructed of much lighter scantling, are proportionally more injured by an equal amount of chemical action. So far as the purposes of construction are concerned, no material equals steel; but if steel ships cannot be protected against the destructive action of the medium in which they must exist, the question assumes another phase, and economical results might be obtained by reverting to iron or wood. As, however, the use of steel enables the naval architect to obtain results in speed and strength and lightness of hull which are otherwise unobtainable, this reversion is practically out of the question. Steel must be used and protected.

In General Information Series No. VII., Lieutenant Schroeder gives a most complete and interesting résumé of the whole question

of protection of the hulls of vessels. He refers on page 277 to the process of lacquering, which has been tried on several of the vessels of the Japanese navy, but without giving any details. It has been my good fortune while on the Asiatic Station to meet Mr. Hotta, and to receive from him quite full information as to his process of lacquering; and I have also had an opportunity, through the courtesy of the officials of the Yokosuka dockyard, of inspecting two of the vessels of the Japanese navy while in dock for the purpose of receiving or renewing their lacquer coats. It was thought that the information thus obtained might be of interest to the members of the Naval Institute, as having an important bearing on one of the most prominent professional problems of the day.

Nearly every book on Japan refers in greater or less detail to the subject of lacquer, but until the substance was analyzed only little was really known of it. It may not be amiss in the consideration of our subject to examine somewhat in detail into the constitution and method of preparation of lacquer, using for the purpose such published accounts as have appeared in the proceedings of scientific societies, or in the works of residents of Japan who had carefully investigated the subject. The lacquer tree is indigenous to Japan, and is also found in Corea, China, and the countries of Farther India. In Japan it is systematically cultivated. New plantations are being laid out in Japan and will commence to yield in five years, and as the whole coast country of Asia is practically available for the cultivation of the tree, it is safe to say that a great demand, such as might be caused by an extensive application of lacquer to steel or iron ships, would create its own supply.



forming a film that protects the lacquer underneath. The ordinary method of application to any surface is by taking a small quantity on a wooden spatula and placing it on the surface to be lacquered, working it down into a thin uniform coat by repeated strokes with a flat camel's-hair brush, the strokes being made in different directions, but in ordinary work most commonly at right angles. The lacquer rapidly darkens to a dark brown, and afterwards dries, forming a lustrous coat. Colors are given to the lacquer coat when desirable by mixing metallic body pigments such as vermilion, cinnabar, ochre, or orpiment.

Lacquer has been frequently analyzed, with somewhat varying results. The analyses given below were made under the direction of Prof. H. Yoshida, Asst. Professor of Chemistry in the Imperial University at Tokio, and recognized as one of the best authorities on lacquer in Japan. They are from a paper contributed by Prof. Yoshida to the Proceedings of the Royal Society of Edinburgh, on the Chemistry of Japanese Lacquer.

The constituents of pure lacquer are found to be a resinous acid, gum arabic, water, and a nitrogenous residue. The method of analysis adopted was to extract the resin from the lacquer by treating it with absolute alcohol, evaporating the solution and drying at 105° to 110° C. The residue was boiled with water and the extract evaporated on a water-bath, giving the amount of gum. The residue from the water solution consists of a coagulated nitrogenous substance and small quantities of coloring matter. The sum of the percentages of the above subtracted from 100 gives the amount of water and volatile matter.

The percentage composition of pure lacquer was obtained from a sample specially collected under official supervision in the province of Yoshino, celebrated for producing the best lacquer in Japan. It yielded the following results:

Soluble in alcohol (urushic acid),	.	.	.	85.15
Gum arabic,	.	.	.	3.15
Nitrogenous matter,	.	.	.	2.28
Water and volatile matter,	.	.	.	9.42
				100.00

Other unadulterated samples gave the following: Number 1 was from Hittachi, 2 from Sagami, 3 from Yechigo, 4 from Sagami, and 5 and 6 commercial lacquers, origin unknown, bought in Tokio.

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	1.	2.	3.	4.	5.	6.
Urushic acid, . . .	64.62	68.83	66.92	80.00	64.07	58.24
Gum arabic, . . .	5.56	5.02	4.75	4.69	6.05	6.32
Nitrogenous matter, .	2.10	2.01	1.72	3.31	3.43	2.27
Oil, ...	0.09	0.06	0.06	?	0.23	?
Water and volatile matter, 27.63	24.08	26.55	12.00	26.22	33.17	
	100.00	100.00	100.00	100.00	100.00	100.00

The quality of the lacquer is determined by the amount of urushic acid. 5 and 6 are fair commercial lacquers. The common adulterations are water and oil. An excess of the former can be expelled by stirring the lacquer. Paint oils are frequently added to the lacquer to increase the transparency and covering power, and may be used up to 20 or 25 per cent without impairing the drying power of the lacquer, although the power of resisting chemical agents, the most valuable property of lacquer, is much reduced.

The principal and by far the most important constituent of the juice is the *urushic acid* obtained from the alcoholic solution. It is a pasty substance of a dark brown color, of specific gravity 0.9851 at 23° C., and having the characteristic smell of the juice. It is quite insoluble in water, and is unacted upon either in air or oxygen, but is soluble in benzene, ether, carbon bisulphide, and chloroform. It is permanent up to 160° C., but above 200° decomposes slowly with carbonization. It is very poisonous, and produces most disagreeable itching when applied to the skin, causing what is commonly known as lacquer poisoning. It is probable that this poisoning is also partly due to a volatile substance given off in the drying of the alcohol

Prof. Yoshida examined many of the metallic salts of urushic acid. They are readily obtained from the alcoholic solution. The iron salts are quite complex and numerous. A small quantity of one of these salts added to ordinary lacquer produces the black lacquer of commerce. Long-continued action of strong hydrochloric acid on urushic acid produced an isomeric form, a β -urushic acid. Chlorine and bromine produced series of substitution products, as did also nitric acid. Many other interesting chemical compounds were obtained, but their consideration is foreign to the present subject.

- The *gum* in the lacquer juice seems to be in the form of gum arabic. An examination gave the following results:

		Arabic Acid ($C_{12}H_{22}O_{11}$).
Carbon,	42.47	42.11
Hydrogen,	6.40	6.43
Oxygen,	51.13	51.46
	100.00	100.00

The physical properties of the gum are those of gum arabic. It exists in the juice in the form of an aqueous solution, and even in hardened lacquer the gum can be extracted by treating it for a long time with water. As it is not therefore an essential part of the varnish, its function appears to be to keep the different constituents of the juice in a state of uniform distribution, and also to assist the adhering power of the lacquer when applied to a surface.

The most important practical question connected with lacquer is that of the drying. Prof. Yoshida examined this most carefully, and his experiments appear to be convincing. It was found, as already stated, that the urushic acid was permanent in air, nor did a mixture of the acid and the gum in the proportions in which they exist in the juice show any tendency to harden. The hardening was found to occur only in the presence of the nitrogenous matter that remained after the urushic acid and gum arabic had been extracted from the juice by absolute alcohol and boiling water. The residue thus obtained is a coagulated albuminous substance, having no action whatever on urushic acid. If, however, the gum is extracted by cold water, the residue shows very marked diastatic properties. Its analysis is as follows:

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	I.	II.	Mean.
Carbon,	59.52	59.72	59.62
Hydrogen,	7.62	lost	7.62
Nitrogen,	5.48	...	5.48
Oxygen,	26.18	...	26.08
Ash,	1.20	...	1.20
	100.00	...	100.00

The substance is slightly soluble in water, and in sodium chloride and weak alkaline solutions. It does not act on sugar solution or gelatinized starch.

Previous experiments having shown that lacquer deprived of this nitrogenous matter would not dry, two series of experiments were made to determine the practical conditions under which the diastatic action of the albuminoid was best carried on. In the first, a small quantity of pure lacquer juice was heated on a water-bath, and the heated juice was then laid in a thin layer on a glass plate and put in a box, the air of which was kept moist. The temperature of the box was kept at 20° C.

1. The ordinary juice dried at 20° C. in 3½ hours in air, and in somewhat less than 2 hours in moist oxygen.

2. The juice heated to 30° C. dried in 4 hours.

3. " " " 40°-43° " 4½ "

4. " " " 50° C. " time not known.

5. " " " 55°-59° C. dried in 24 hours.

6. " " " above 60° C. did not dry.

In juice containing a larger quantity of the albuminoid and

5. In dry hydrogen the sample did not dry.
6. In moist hydrogen the sample dried imperfectly in a day and a half.
7. In dry carbonic acid the sample did not dry.
8. In moist carbonic acid the sample dried in two days.
9. In dry nitrogen the sample did not dry.
10. In moist nitrogen the sample dried imperfectly in a day and a half.

More careful experiments made in hydrogen and carbonic acid in eudiometers standing over mercury showed that the lacquer would not dry.

As the result of these experiments the inference is legitimately drawn that the presence of oxygen and moisture is necessary for the drying of lacquer, and that the action is best carried on at a temperature of about 20° C., ceasing at the limits of 0° and 70°.

In order to determine the exact nature of the chemical action involved in the drying, a specimen of pure juice was taken, rapidly heated over the water-bath so as to coagulate the albuminoid, and the heating continued long enough to expel all water. Analysis then gave the following :

Carbon, ...	75.54
Hydrogen, ...	8.97
Nitrogen, ...	0.11
Ash, ...	0.21
Oxygen, ...	15.17
	100.00

Lacquer naturally dried was heated to 100° C. and analyzed :

Carbon, ...	70.87
Hydrogen, ...	8.225
Nitrogen, ...	0.092
Ash, ...	0.032
Oxygen, ...	20.781
	100.00

The general action in drying is, therefore, that the lacquer takes up oxygen, and Prof. Yoshida states that the difference between the analyses is accounted for by the supposition that each molecule of urushic acid, $C_{14}H_{18}O_2$, has taken up one atom of oxygen and

changed into *oxy-urushic acid*, $C_{14}H_{18}O_5$. To test further this supposition, urushic acid was repeatedly subjected to the action of strong chromic acid containing an excess of sulphuric acid. The product was cohobated with alcohol to dissolve the unattacked urushic acid, and dried at 106° C. The result was a brown powder. The mean of four analyses of this substance as compared with the theoretical composition of oxy-urushic acid is as follows:

	Mean.	$C_{14}H_{18}O_5$.
Carbon,	71.61	71.79
Hydrogen,	7.94	7.69
Oxygen,	20.45	20.52
	100.00	100.00

This oxy-urushic acid is a very stable substance, being unacted upon by any reagent except hot fuming nitric acid, which gradually changes it into a yellowish spongy substance, $C_6H_{18}(COOH)_4$. It is to the presence of this oxy-urushic acid in hardened lacquer that its strength and durability are due.

Prof. Yoshida sums up the chemistry of lacquer in the following words:

1. "Lacquer juice consists essentially of four substances; viz., urushic acid, gum, water, and nitrogenous matter.
2. "The main constituent, urushic acid, is a stable acid, capable of forming many well-defined salts and derivative compounds.
3. "The gum is probably identical with gum arabic.
4. "The nitrogenous matter has a composition allied to albumen, with much less nitrogen, and has a peculiar diastatic property.

addition of pure urushic acid, which brings down the relative amounts of gum and nitrogenous matter. The lacquer becomes thus more transparent and gains in strength.

9. "The mixture of 20 to 25 per cent of drying oil with the juice does not much impair the essential quality of the lacquer."

THE LACQUERING OF SHIPS.

The idea of lacquering iron and steel vessels as a protection against the action of sea-water was suggested to Mr. Hotta, a lacquer manufacturer of Tokio, by the observation that pieces of old lacquer recovered from the sea showed but little action, the lacquer being practically unattacked. As the Japanese were then purchasing iron and steel ships from abroad, and were encountering the same difficulties that were met with elsewhere in protecting the metal, experiments were made on special test-plates, which were immersed in sea-water for considerable periods, generally at the Yokosuka dockyard. The first results obtained were not fully satisfactory, but were very encouraging, and the tests were continued, varying slightly the composition of the lacquer, or adding chemicals to assist in obtaining the desired results. In June, 1886, a practical test was made by lacquering about 1200 feet of the bottom of the Fuso-Kan, using the preparation of lacquer that at that time had given the best results. The ship was docked again in September, 1887, and the condition of the lacquered portion was so satisfactory that the Admiralty gave an order to lacquer the whole bottom. In December, 1888, the ship was again docked, but the lacquer coat was found to be so good that no repairs were made. In June, 1889, the ship was again docked, the lacquer being still satisfactory. In each case anti-fouling paint was applied over the lacquer. The Fuso was docked once more in April, 1890, and although the lacquer covering was almost perfect, it was for some unknown reason all removed by scraping, and the bottom was painted.

Many other vessels of the Japanese Navy have since been lacquered, a list being appended. Experimentation has been going on continually. The work is all done by Messrs. Hotta & Co., they holding a monopoly under the laws of Japan, practically the equivalent of an American patent. Not content with merely protecting the metal against corrosion, the contractors have endeavored to meet all the requirements of the case by providing an anti-fouling lacquer preparation, as well as an anti-corrosive, the use of metallic anti-

fouling paints over the lacquer having been found to be injurious, the urushic acid of the lacquer sometimes attacking the metallic base of the paint, resulting in the practical destruction of the useful qualities of both. This preparation was developed experimentally, and test-plates coated with both protective and anti-fouling lacquers having given most satisfactory results immersed in sea-water at Yokosuka for eighteen months, the Japanese Admiralty ordered the lacquering of the new despatch-vessel Yaeyama with both kinds of lacquer. The work was performed in July, 1890, and the result will be watched with interest, as the test-plates remained perfectly clean; and if the same protection is afforded to the Yaeyama under the ordinary conditions of service, the anti-fouling lacquer will have vindicated its claim to be the equal if not the superior of any similar composition known.

The protective or anti-corrosive lacquer is mainly lacquer, small quantities of some inert minerals like mica or kaolin being added to increase the covering power and body of the preparation. The composition of the different coats differs somewhat, that applied directly to the skin of the ship containing the largest proportion of lacquer.

In the first experiments special pains were taken to have the plates perfectly clean, the metal being washed off with acid in order to remove all oxides, but this process was soon discontinued, as the lacquer coats when applied to the clean iron were found to blister considerably. In later experiments the steel was merely brushed clean, removing all non-adherent oxides or films, the lacquer being applied over all adherent substances. An important point in which



The method of lacquering is as follows: The ship is docked and the bottom carefully scraped of all yellow rust, old paint, or other matter that is not strongly adherent. If old paint adheres firmly, it is considered unnecessary to remove it. The bottom of the ship is then shut in by screens of old canvas suspended from just above the water-line to the bottom of the dock. In winter, stoves or other heating apparatus are placed inside this screen to raise the temperature and thus facilitate the drying of the lacquer. It has been proposed to allow exhaust steam to escape inside the canvas screen to secure the requisite warmth and moisture for the drying; but although this practice is common in lacquer manufactories, it has not yet been tried on ships. In summer, the screen around the bottom is necessary in order to screen the metal from the direct rays of the sun, which might raise the temperature to such a point as to impair the lacquer by a partial coagulation of the albumen. With the screen in place, the lacquering can be carried on in almost any weather. When everything is in readiness, the first coat of protective lacquer is applied, and worked down into a smooth uniform coating by a soft brush, as already described. One man can lacquer about 500 square feet, one coat, in eight hours. The time of drying of the first coat, which, as already stated, is almost pure lacquer, may vary from three or four hours to one day, according to the temperature and moisture of the air. In cold weather the drying process is tedious.

As soon as the first coat is dry the second is applied. This may contain mica or kaolin in small quantities, as also the outer protective coats. Five protective coats have generally been applied to the Japanese men-of-war, but a smaller number may be used when the anti-fouling lacquer is applied over them. The inner coat of the anti-fouling preparation is principally lacquer, the amount of poisonous mercury salt contained in the preparation increasing with each coat. The only ship that has thus far received both preparations, the Yaeyama, has four coats of the protective and three of the anti-fouling.

The number of coats considered necessary is at least three of the protective and the same number of the anti-fouling lacquer. Under favorable circumstances the ship would not be in dock more than six days, but ten would be more probable. The cost of the lacquering is stated by the contractors as five yens for thirty-six square feet, about thirteen cents U. S. gold per square foot. If the work were to be carried on more generally, the expense could be reduced, as a

permanent corps of employes have to be maintained, although frequently out of work. Work has been done at much less than the above rates. The chief, in fact the only serious, objection to the use of lacquer is the expense: If dockage is cheap, this is not excessive, but the long time involved for the proper drying of the lacquer coats renders the operation a very costly one when the dock charges are high. The vital question is whether the protection afforded is worth the expense. If absolutely complete, preventing all deterioration or fouling of the hull, it would be economy to pay the highest charges in order to have the vessel always sound and in condition for service. It is just becoming known outside of professional circles that steel vessels are expensive, and that more money may be spent in excessive coal bills in trying to force a foul hull through the water than would be expended with proper economy in the frequent dockings necessary for keeping the hull clean.

It cannot be said with certainty that the use of lacquer is more expensive than the ordinary methods of protection. This depends very largely, of course, on the dry-dock charges. The contractors claim that one thorough lacquering of a vessel's bottom will keep it clean and protect the metal for three years. The expense of this operation may be figured up as follows:

Taking the Charleston, for instance, we have:

Cost of cleaning and lacquering 20,000 sq. ft. at 13 cents,	\$2600
Docking and nine "lay days,"	4300
	\$6900

in relation to the work on the *Chicago* in government docks, we have the cost of one docking and painting at New York as follows :

Docking, ...	\$400
Painting, ...	1000
	\$1400

Assuming that the cost of lacquering in the United States would be twice that in Japan, we have :

Docking, ...	\$400
Lacquering 21,000 sq. ft. at 26 cents, ...	5460
	\$5860

Taking the cost as before for three years, we have :

Painting, ...	$\$1400 \times 6 = \$8400$
Lacquering, ...	5860

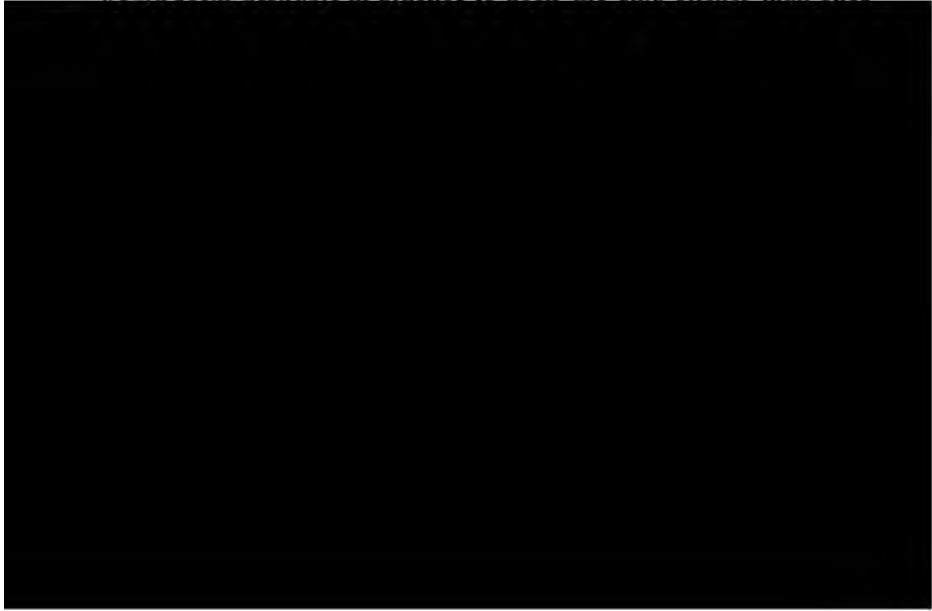
It may be questioned whether the lacquer will last three years, and it is also possible that the painted ship would need docking oftener than once in six months. In the absence of data a careful estimate is impossible, but enough has been shown to render the statement probable that protection by lacquer is not in the *long run* expensive.

The experience of the Japanese navy must be largely relied on, and the unanimous testimony of all the naval officers whom I have met is that lacquer affords excellent protection to the hull, but is expensive. It is noticeable that the work is being continued in the Japanese navy in spite of the expense.

Through the courtesy of the officials of the Yokosuka dockyard I was allowed to inspect the condition of the lacquered bottom of the *Takatchiho* in January, 1890, the ship having been in the water since May, 1889. The water-line belt had been lacquered in September, 1886, and repaired in May, 1889, when the rest of the ship was lacquered, as a result of the good condition in which the belt was then found. When the bottom was examined in January, 1890, it was found that on the bilge and floor plates the lacquer was perfectly smooth and unbroken and had afforded complete protection to the metal. On the sides below the water line there were numerous small blisters, averaging about a quarter of an inch in diameter; but these were dry inside, the lacquer coat being unbroken and the

metal underneath was bright and uncorroded. Occasionally larger blisters were found which contained water, the film of lacquer having become broken. Underneath these the metal was dull but uncorroded, and there were no signs of rust. In cases where the lacquer had been scraped off, rust cones had formed, and their position marked the number of breaks that had occurred in nine months. In the entrance, especially in the wake of the anchors and chains, the lacquer was considerably broken and the metal consequently rusted, but in no part of the hull was there any extensive corrosion or pitting, except *underneath* the lacquer, showing that it antedated the application of the lacquer in May, 1889. An interesting feature illustrating the effect of the lacquer in preventing galvanic action existed in the starboard side of the run, where some of the plates showed extensive corrosion under the lacquer, apparently the result of galvanic action between the steel and the propeller and its fittings. Here was not a single rust spot, showing that no corrosion had taken place since the application of the lacquer.

The impressions derived from the appearance of the bottom of the Takatchiho were that lacquer is a perfect protection against the action of sea-water, *so long as the coat remains unbroken*. Although much more elastic and adherent than any kind of paint can be, it is somewhat susceptible to mechanical injury, and especially so forward where the anchors and chains and the impact of floating bodies are liable to break it. Every break becomes a spot of corrosive action or pitting. As it seems impossible to prevent this injury, and as the protection afforded by the lacquer is that of the worst portion, it would seem desirable in practice to dock the ship oftener than once



MEN-OF-WAR LACQUERED BY MESSRS. HOTTA & CO.

Japanese.

Fuso.—June, 1886, 1224 sq. feet lacquered for trial. Sept., 1887, entire bottom lacquered. Dec., 1888, docked but no repairs made. June, 1889, slight repairs made. March, 1890, lacquer scraped off.

Riujo.—April, 1888, armor shelf lacquered. A wooden ship copper sheathed; armor belt much corroded.

Tsukushi.—August, 1887, entire bottom lacquered. June, 1888, docked but no repairs. Feb., 1889, slight repairs.

Naniwa.—Sept., 1886, 5200 sq. feet (water-line belt) lacquered. May, 1888, additional surface lacquered. Feb., 1889, entire bottom lacquered.

Takatchiho.—Sept., 1886, water-line belt lacquered. May, 1889, entire bottom lacquered. Jan., 1890, docked and slight repairs made.

Atago.—May, 1889, entire bottom lacquered.

Torpedo-boats 1, 2, 3, 4, 5.—April, 1887, entire bottom lacquered. These boats have all been docked since and slight repairs made as necessary.

Kotaka.—Sept., 1888, entire bottom lacquered.

The above were lacquered with the anti-corrosive preparation only, generally five coats. Metallic anti-fouling paint was used over the lacquer, and the vessels had to be docked to renew this paint.

Yaeyama.—July, 1890, entire bottom lacquered with four coats of protective and three of anti-fouling preparations.

Russian.

Battle-ship Dmitri Donskoi.—Nov., 1886, armor belt partly lacquered. Nov., 1887, armor belt wholly lacquered. Oct., 1888, lacquer on steel portions was found to be in very good condition. On the zinc sheathing it had been detached through the action of the urushic acid on the zinc.

Admiral Nakhimoff.—Aug., 1889, steel armor belt found to be very much corroded and was therefore lacquered.

NOTE BY LIEUT.-COMMANDER CLIFFORD H. WEST, U. S. N.

Messrs. Hotta and Company of Tokio, Japan, have sent two plates to the United States for trial by the U. S. Navy Department. One

472 PROTECTION OF THE HULLS OF VESSELS BY LACQUER.

plate is of steel and one of iron, each four feet square, and covered with three coats of anti-corrosive and three coats of anti-fouling lacquers. These plates arrived at New York City in November, 1890. Chief Constructor T. D. Wilson, U. S. Navy, has directed that the plates be submerged in tide water at the Navy Yard, New York, for a period of three months, when they are to be taken up, and a report made to the Bureau of Construction and Repair as to their condition.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, M D.

THE SYSTEM OF NAVAL TRAINING AND DISCIPLINE
REQUIRED TO PROMOTE EFFICIENCY
AND ATTRACT AMERICANS.

BY LIEUTENANT W. F. FULLAM, U. S. NAVY.

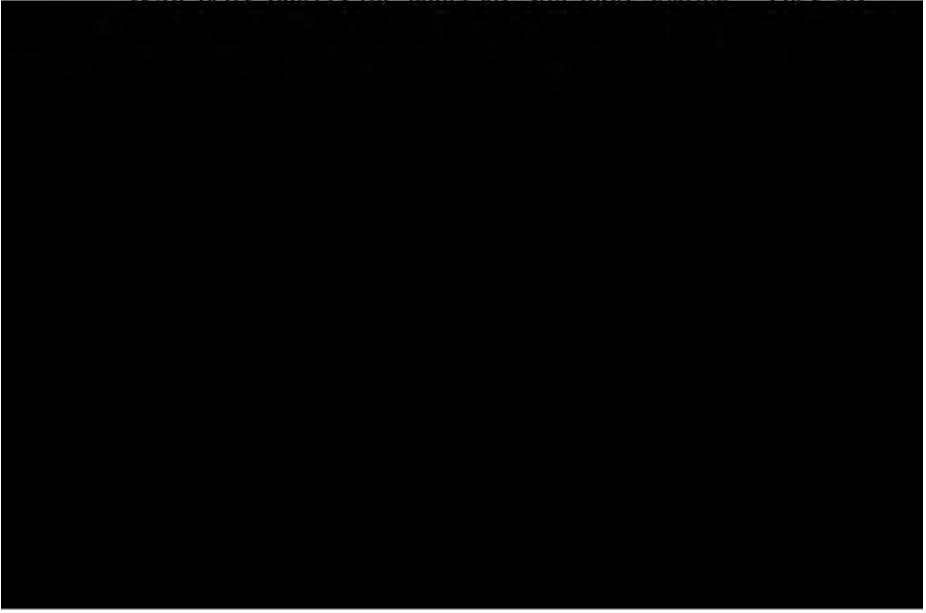
The abandonment of sail power in ships of war—even in cruising ships; the introduction of many complicated weapons that require great care and skill for their effective use; the probability that naval battles will be shorter in the future than in the past and blunders far more fatal—these and many other facts emphasize the importance of a change in the training of men-of-wars-men. The modern ship has become pre-eminently a floating battery, as seen in the change of type from the Hartford to the Baltimore. It follows, logically, that the men to man such ships should be, pre-eminently, naval gunners—not sailors of the old school. All other than military elements have been reduced to a minimum in naval warfare and in naval architecture, and it is consistent with such a transformation that the training of the personnel should be more military, if efficiency in war is to be the aim of a navy.

Modern ships are building for the United States Navy, to be armed with the most improved weapons. The efficiency of these ships in battle will depend upon the organization and training of the personnel. A gun or a torpedo will do little harm in unskilled and unpatriotic hands. Powerful ships will not win with crews composed largely of badly trained foreigners. It is essential, therefore, that the personnel of the navy should receive as much attention as the material of war during this era of change, and it may be well to consider the service to-day, particularly the enlisted man as we find him on board ship—his habits, character, and training—with a view to improvement in organization and esprit.

It will not be denied that far greater skill and coolness are required to point a gun or a torpedo afloat than from the shore. In fact, all the conditions of battle on board ship call for quicker action, a truer eye, and greater intelligence than is demanded in directing the same weapons on land. *It follows, therefore, that a navy should not be formed of men less skillful and less trustworthy than soldiers, but rather of a higher type if possible.* Let it be considered how far the system now in vogue in the United States Navy is designed to attract and develop such men.

Personal observation and study of the men on board the new cruisers must convince the most conservative officer that the sailor fails to meet modern requirements, and that this failure is to be attributed more to his training than to a lack of intelligence. Officers who are in daily contact with, and who are charged with the military instruction of, the sailor will naturally be the first to discover his faults: they will see that he is not attentive enough; he is too careless in little things, thoughtless in handling new and complicated weapons. It is difficult to fix his attention, to stop his talking, laughing, and trifling at drill. Much time is wasted in his instruction—months are consumed where days should suffice—and the best results are never attained. The sailor will work uncomplainingly for hours scrubbing decks and paintwork; but the divisional officer, in attempting to arouse in him a spirit of pride in military matters, finds himself heavily handicapped at times by the extreme listlessness or weariness of the sailor, who appears to regard military duties as of secondary importance.

With petty officers the faults are still more glaring. They are



responsibility in matters of discipline. As in the old days of sails, when activity aloft and seamanship pure and simple were the chief requisites, the strictly military duties on board ship are performed by the marines. Here we come to the real cause, direct and indirect, for the absence of military instincts among men-of-wars-men—the fact that a company of soldiers is placed on board ship to do the military duties, to watch and search and discipline the sailor. Quite naturally the latter feels relieved of all responsibility in such matters. Petty officers regard discipline as foreign to their duties, and they are perfectly excusable for taking this view of the case. A general laxity results, as might be expected. To get ahead of the marines, to circumvent them and deceive the officers who direct them, is regarded as perfectly justifiable. A policy of espionage tends to bring out vicious qualities and to stifle the better impulses in all men—even in sailors.

Nothing could be more harmful to the sailor than the presence of the marine guard afloat, because it prevents the development of a military spirit and deprives the sailor of the duties and responsibilities that cultivate the qualities we most require in these days—exactness, care and trustworthiness.

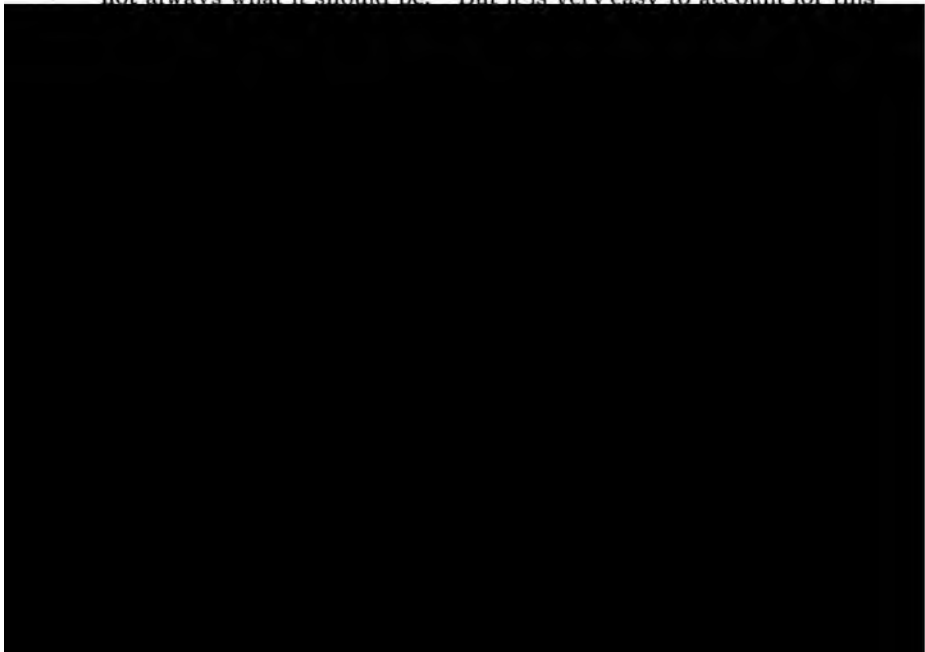
Moreover, the effect upon the sailor is discouraging and debasing. He is searched at the gangway like a pickpocket and shown in a dozen different ways that he is neither respected nor trusted. The good as well as the bad, the petty officers among them, are frequently subjected to humiliating treatment—treatment that has the inevitable tendency to drive good men out of the service and to keep those in who have little self-respect. No man—not even a sailor—is made trustworthy if he is never trusted, nor respectable if he is never respected. A system of discipline ignoring such a cardinal principle is responsible for the low standard in the navy, and for the fact that the tendencies and habits of the men forward of the mast are not what they should be.

In discussing this question of the employment of the marines afloat it is to be understood that the efficiency of the marine as such is not attacked. It is simply a question of the moral effect upon the sailor of placing a guard over him *and teaching the officers not to trust him*. Aside from their duties as police and sentries, there is no necessity whatever for retaining marines afloat. A special corps of sharpshooters is no longer necessary, because all sailors should be taught to shoot as well as marines, and it is reported that the

latest target returns at the Navy Department show that the sailor is not inferior to the marine with the rifle, notwithstanding the fact that the marine would naturally strive to excel in this one particular. And considering the type of man that is needed under the conditions of modern warfare afloat, there is no more reason for having a special police force on board ship than there is for a similar force in every regiment of soldiers. The man-of-wars-man of to-day should be as competent to perform all military duties afloat as is the soldier to do the same duties on shore. It was after a careful consideration of modern requirements that the Organization Board, forced logically to the conclusion that marines were no longer needed on board ship, recommended by an almost unanimous vote that they be withdrawn from service afloat.

The presence of the marine on board ship degrades the whole service in that it deprives the sailor of a military training, reduces the petty officer to a nonentity, and thus throws many trifling duties and burdens upon the commissioned officer. The latter must follow up the afterguard-sweeper to see that he gets the sand out of the corners, and superintend everything day and night, trusting nothing to the petty officer. His time and energies are wasted in doing a petty officer's duties. The petty officer, relieved of his proper functions, becomes one among the men, and the latter respect and obey officers and petty officers accordingly.

The complaint is frequently made that the sailor is listless and indifferent and that he shows a deplorable lack of personal interest and pride in the service. The feeling between officers and men is not always what it should be. But it is very easy to account for this



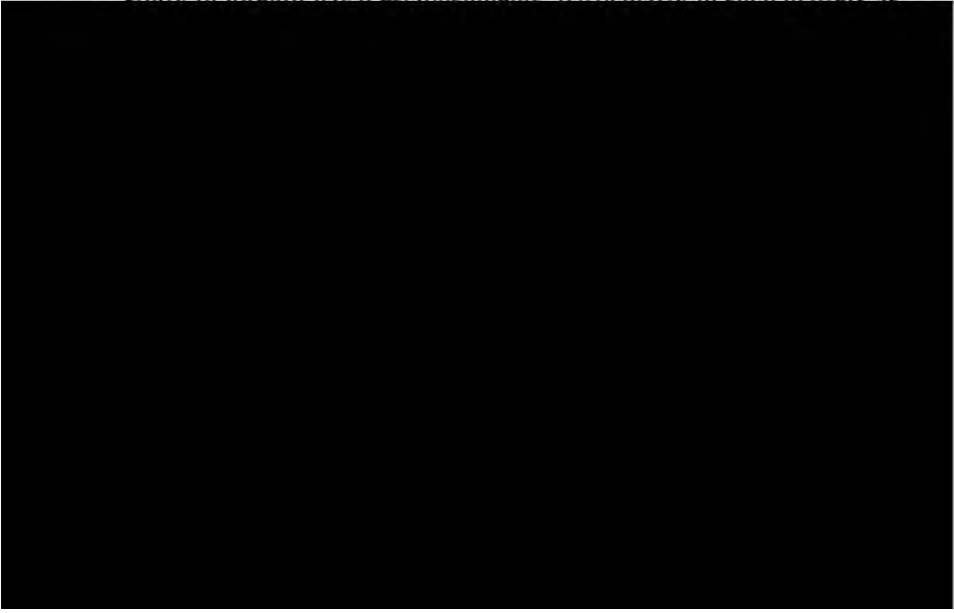
Note the difference: the sailor is told that he is untrustworthy; the marine is told that he must be trustworthy. The sailor is told that he must be watched and searched; the marine is told to do the watching and searching. The sailor is told that military duties and responsibilities are not his; the marine is required to be strictly military at all times, careful, thoughtful, and ever attentive to little details. The sailor is debased, and his interest and pride in the service are lessened by such teaching; the marine is brought under elevating influences, his manliness is appealed to, and his efficiency is obtained at the expense of the sailor. Apply to the marines and their non-commissioned officers the treatment accorded the sailor in matters of discipline, and the corps would be ruined in a month. Here is the explanation of the sailor's attitude, the reason for his lack of pride—there is a "bulwark" between officers and men. They have lost touch with each other, and there cannot be that mutual feeling of confidence and respect that should exist between them. When this "bulwark" is removed, and the sailor is told that there is no duty too good for him on board ship; that he is required to be trustworthy and respectable; that he must do military duties; that he will be supreme in his own sphere, and that promotion will result from the faithful discharge of military obligations—when this is done, the sailor and the petty officer will be as trustworthy as the marines. *A better class of men—more Americans—will enter the service and discipline will be greatly improved.*

As a rule the marines are not better men than the blue-jackets. The majority of them come from the same class. Scan their faces and they are no brighter. There is no element in the corps as valuable and intelligent as the apprentice, if the latter were only retained and developed. It is principally a difference in training and in clothes. A good man is more likely to be recognized in a frock coat than in a blue shirt. Why should better men enlist in the marine corps? Neither the pay nor the opportunities for promotion are so good. If trustworthy men can be found for \$13 and the clothing allowance of \$3 per month, it is because they are trusted and treated like men. Treat the sailors more like men and a better class will enlist. It is not so much because the peculiar duties required of sailors are objectionable. *Men will accept these conditions if they are paid, promoted, and respected for faithfulness and efficiency.*

Aside from the moral effect of refusing to trust sailors to disci-

pline themselves, there are certain practical considerations calling for the abolition of marines on board ship. The engineers' force in a modern ship is proportionally much larger than in ships of the old type, and there are fewer hands available, as a rule, for the duties of cleaning and caring for a ship. Out of a crew of 180 men how many do we get to scrape the ship's bottom in dry dock? Not more than 50! Modern guns and steel ships require more care for their preservation, and there should be as few passengers and idlers as possible. Every man on board ship should do his fair share of the cleaning and drudgery. It is absurd that there should be forty marines on board the Boston, occupying one large compartment of the berth deck, contributing little to the cleanliness of the ship, with nothing to do but to watch the scuttle-butt, attend the commanding officer, stand by for ceremonies, and guard the men who form the bone and sinew of the service and upon whom the navy must depend for success in battle. All these duties are of a comparatively trivial nature and could be performed by twelve or sixteen men *if petty officers were utilized in matters of discipline*. If there is room for forty marines on board the Boston there is room for forty sailors in their stead, and the latter will be available for general naval duties, and will contribute far more to the efficiency of the ship in time of peace and in time of war.

To cite foreign navies as authority for the retention of marines is a poor argument and its weakness is easily exposed. Some foreign services have marines afloat and some have not; this argument works both ways. It is admitted that much can be learned by the study of foreign naval establishments, particularly in such matters as



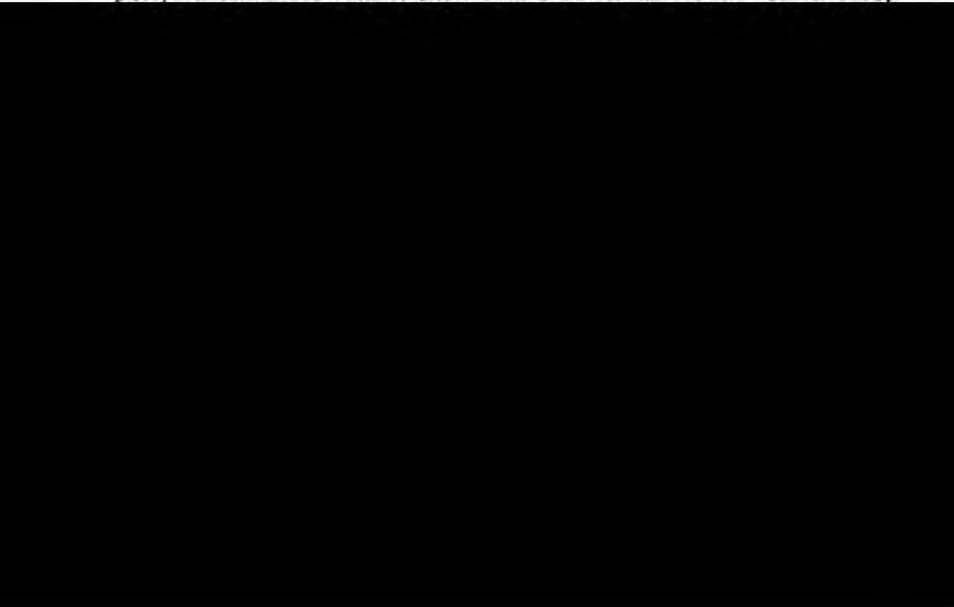
promotion, and we ought not to bid for men who have no ambition. He will not enter a service where, *in the name of discipline*, respect and consideration are withheld from him. Foreign wages and workingmen's conditions are not acceptable to Americans, and no more are foreign systems of naval pay and discipline. It is folly to bemoan the fact that the American is unlike the foreigner in this respect—the fact must be recognized. The navy cannot undertake to reform 65,000,000 people. The wise policy for the navy is to conform to the national institutions of the country it is supposed to serve, and naval officers will find in the study of the personal traits of their own people the only sound and practical principles upon which to base a system of discipline for the United States Navy.

The present condition of the personnel of the navy is eloquent proof that the system of pay, discipline, and promotion is not designed to attract and retain a sufficient number of trustworthy Americans. Not half of our sailors are American born. All languages are heard on our decks. It is an international navy. Modern ships are building to be manned by this heterogeneous crowd! What pride can an officer feel in his vain attempts to arouse some national spirit and esprit in such crews? There are some excellent men in the service, to be sure—some Americans who are perfectly trustworthy, though little trusted—a few who have a natural love for the navy and are not driven out by their discouraging surroundings. Many of the foreigners are good men also; but the navy should not be a training school or an asylum for such. The fact that the service is more pleasing to foreigners than to Americans proves that the treatment of the personnel is already in conformity with foreign rather than with American institutions. To continue such treatment, or to look abroad for a solution of the problem, will simply perpetuate existing evils and give us a *navy largely composed of men who have no pride* in the service, and foreigners, many of whom cannot speak English. An ancient system applied to modern conditions, a foreign mold for the native mind, will never attract the type of men needed to make the much vaunted "new navy" an efficient and patriotic service.

It is easy to explain why Americans of the proper class do not flock into the line of the navy, and why so many refuse to stay after serving for a time. It is simply because the profession of a man-of-wars-man is not regarded as being sufficiently respectable. The "Jacky" that we hear so much about is popularly regarded as a harum-scarum

creature, quite unlike other human beings, quite unworthy of trust and responsibility. Officers have done much to give the sailor this reputation, by their attitude toward him. If they insist that he cannot be trusted and must be watched and disciplined by marines, how can people at large think any better of the sailor? When he is fortunate enough to get a billet as ship's writer or yeoman, when, in other words, he ceases to be a sailor and becomes a non-combatant, he dons a sack-coat, gets good pay, and is regarded as being respectable—he is no longer searched at the gangway. There is not much inducement for a man of any ambition to remain a blue-jacket. Promotion in the line, to a petty officer's rank, means practically nothing. Although it has always been recognized that an army cannot be efficient without good non-commissioned officers, it appears to have been decided in the United States Navy that a petty officer can have nothing to do with the military discipline of a ship. In this the man-of-war element is belittled—it affords no career. The non-combatant and fancy elements are exalted, although the service is maintained for purposes of war. A citizen of this country cannot be advised to put his son into the navy with the idea that he shall follow for life the profession of a man-of-wars-man. The young man must work for a clerkship if he wishes an honorable and paying position afloat in a ship of war.

In view of these facts it is not to be wondered at that 90 per cent of the apprentices leave the service. As soon as the novelty wears off they see that they can do better outside. They find little national pride and spirit in crews composed so largely of foreigners, and the petty office carries with it little that satisfies ambition. As a rule,



un-American requirements, drives back to civil life an element that should be retained at all costs.

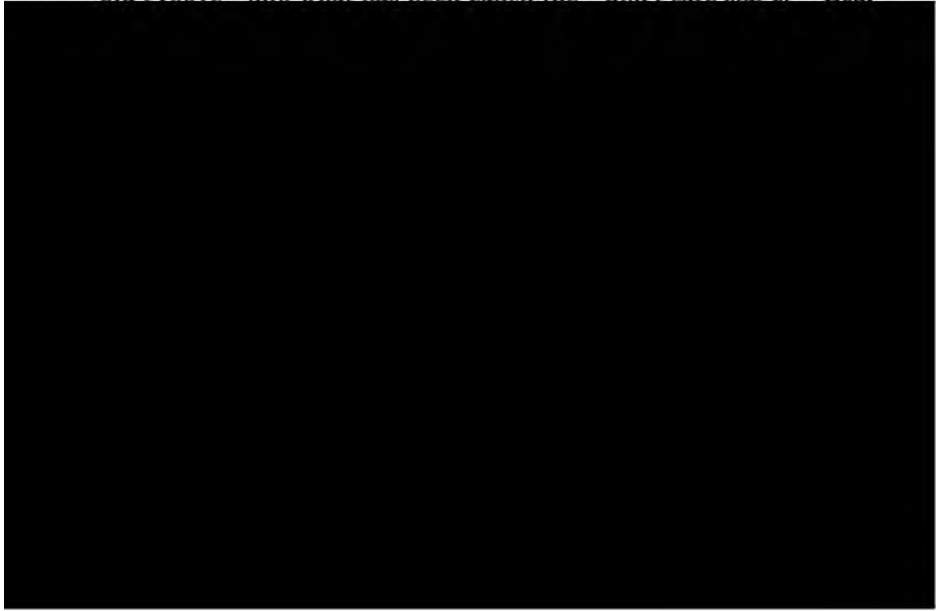
The service afloat should be, above all things, a *practical school*. Examine it as such. It has already been shown that the sailor and the petty officer are not properly developed, and that the apprentice—the best American element—is lost. Surely these are not good “practical” results. Next consider the officers. The Naval Cadet is not developed as he should be after he enters this “practical school.” The system is rather one of repression as far as he is concerned. Individuality and independence are constantly discouraged. In his relations with his seniors there appears to be a fear lest he may assert himself too much. Many of the duties to which he is assigned belong properly to petty officers. The reason given is that he must be “kept busy.” Suppose the graduates of West Point were “kept busy” by assignment to the duties of non-commissioned officers? The latter would be ruined, and the efficiency of the army would be imperiled. The result in the navy is similar.

There are, of course, certain subordinate duties that a cadet must perform. But he should be given as much watch duty as possible, and his manliness should be cultivated from the start. He can be “kept busy” on board a modern ship and developed at the same time, both mentally and physically. Instead of copying the log it would be better to require him to write up the systems of ventilation and drainage, the machinery, etc. He should be required to study and report upon the watch, quarter, and station bill, which will, of course, embody all the principles of modern organization! Instead of discouraging the formation of an idea or the expression of an opinion by a cadet, it would be wise, rather than dangerous, to invite both, and to point out his errors, as would be the course with any young gentleman in civil life. Such treatment would inspire genuine respect for his seniors. Officers who have passed through the steerage, and whose memory has not failed them, should have learned how respect and hearty support are best secured from cadets, and the treatment that produces the opposite result. The Naval Cadets, as graduated from the Naval Academy to-day, are not less “practical” in all that properly belongs to their station than any other grade in the navy; and a searching examination of all officers would establish this fact, even in the case of many who pride themselves upon being “practical.”

The ensign, at times, has been given no better chance to develop

than the cadet. At an age that would make him eligible as a Senator or a Representative in Congress—at an age when he is best qualified mentally and physically for watch duty, and most needs contact with, and practical experience in command of men, he is deprived of such duty. It is unnecessary to dwell upon this subject. Every ensign should stand regular watch on board ship, even if he cannot be a wardroom or divisional officer. No harm will be done by increasing the number of watches. Officers will devote more time to the study of tactics and practical naval matters. *Those who have passed through the junior grades during the past decade can bear testimony to the fact that their minds have been subjected to a smothering, stunting process that has not properly prepared them to meet the demands that war would inevitably impose upon the younger officers of the navy.* Nothing could be less “practical” than this.

Nor does the divisional officer escape the professional wet-blanket. His intelligence is not fully utilized afloat. The fatigue of petty duties prevents the proper development of his mind professionally. By reason of his contact with the men on deck and at drill, he may see much that his superiors have no opportunity to observe. He may notice the beginning of bad tendencies, the cause, and the necessity for changes in organization and training. But he is seldom encouraged to report what he sees. He is often considered a growler or a disturbing element merely because he is using his brains. A few vain attempts to improve matters, by suggesting changes or reporting defects, may meet with the cold-water treatment, if not with something worse, and he soon falls back into the old groove—into what has been called the “don’t care stage.” Zeal



that, as a rule, officers in the junior grades of the United States Navy find themselves treated with more consideration and their intelligence more fully utilized on shore at the Bureau of Ordnance, at the Naval Academy, at the Intelligence Office, and other stations, than afloat in ships of war. *In this there is a natural tendency for brains to seek the beach and stay there.* The system that produces this result cannot be considered "practical" in a naval sense. Now as to questions of organization and routine in this "practical school" afloat: ingenuity could not well devise a worse system of messing than that now in vogue. The best marksman in a ship may be in the powder or navigator's division, and the poorest at the heaviest gun. Target practice is conducted so carelessly at times as to arouse no enthusiasm or pride among officers and men. There are few instances where a spirit of rivalry has been cultivated among the different ships of a squadron. *Owing to the fact that there is little care shown in selecting gun-captains, and no permanency in the rate, there is no certainty that the men who get the little experience at target practice in time of peace will be at the guns in time of war.* In fact, it is evident that in many cases they will not or ought not to be there. Therefore, as far as it may influence accurate shooting in battle and determine the result of a fight, much of the ammunition expended in target practice might as well be dropped overboard.

There is, or should be, one essential difference between a yacht and a man-of-war. On the latter, men should be trained to take more pride in military duties than in anything else. Routine cleaning is very important, but it should not be kept uppermost in the minds of men-of-war-men. Suppose a regiment on shore spent most of its time in cleaning its barracks, and suppose non-commissioned officers were appointed for ability in that direction, would efficiency as a military organization be judged by such work—work that women could do as well as men? The same principle applies to the navy.

To sum up, it appears that in the service afloat, sailors, petty officers and officers are not properly developed in a military direction, and that important problems in organization and training are left unsolved in the absorbing work of carrying out a "routine." But what is the "practical" value of a routine if it fails in such particulars? It has come to pass, as a result of such a routine, that the service afloat is less "practical" than any other part of the naval establishment, and that is saying a great deal.

It will, perhaps, be admitted that the navy of each country should be organized and trained with due regard to the peculiar conditions which war would impose upon that country. In the case of the United States the navy is very small, considering the task that would fall to it in the event of war. It is a mere nucleus, and would of necessity be recruited to three or four times its present size. It would fight at great disadvantage along an extensive coast, against heavy odds, with scant material, and with comparatively few ships and guns. Every man and officer would suddenly find himself in a position of responsibility far in advance of that he holds to-day. It follows from this that men and officers should be prepared for quick promotion—ready for the duties of the next higher grade. If possible, every man should be an American, competent to lead the recruits. In short, it is undeniable that this nucleus should be the most perfectly trained of all navies.

But, as it is organized and conducted to-day, these essential conditions and requirements are to a great extent ignored in the United States Navy. Instead of preparing a man or an officer to do the duties of his own grade or the next higher, he is required in many cases to do the duties that properly belong to the next lower. Instead of encouraging officers to study and anticipate the war problems that may at any time fall to them to solve, their minds are kept on petty officers' duties. Instead of developing the petty officer and preparing him for greater responsibilities, he is practically reduced to the ranks. Instead of attracting Americans, we cling to a system that invites foreigners and repels Americans. Instead of establishing a high standard and developing a trustworthy self-



2d. To raise the standard and develop the type of man required under modern conditions in a navy which is a mere nucleus in time of peace.

3d. To improve the discipline and military efficiency by inspiring not only the officers, but the men with a feeling of personal pride and interest in the service.

To secure the first result, the passage of the Alien Bill is absolutely necessary. It is reported that there was some opposition to this bill on the ground that its passage would render it difficult to recruit the navy. But the folly of such opposition is apparent. It is important that the sailors, as well as the officers, should be citizens of the United States. If the conditions are such that Americans will not enlist in the navy, the sooner these conditions are changed the better. A system that attracts foreigners should give way immediately to one that will attract Americans. The bill should pass, even if the ships of the navy are laid up for lack of men or manned with half crews for months to come. Proper concessions to national traits and institutions will convert the navy from an international to an American service. Until these concessions are made there can be no American navy, properly speaking. It will continue to be a more or less mercenary service, inefficient in time of peace, and lacking in the loyalty and esprit essential to success in war.

QUARTERS AND COMFORTS FOR THE MEN.

An important concession must be made in the matter of quarters and the conditions of life on board ship. Americans of the proper class will not submit voluntarily to the discomforts that foreigners are compelled to accept under enforced enlistment. This fact may as well be recognized first as last. Ships like the *Charleston*, *Philadelphia*, *Baltimore*, *Newark*, *San Francisco*, and *Yorktown* are not designed to attract Americans, but rather to keep them out of the service. The uncovered gun-decks of these ships are an abomination in more respects than one. The living space for men is insufficient, and in bad weather they will, at times, be compelled to live little better than pigs in a pen. It is an unfortunate fact that some of these cruisers will be far more uncomfortable for their crews than ships of the old type. In this there is a step backward, an utter disregard of the means necessary to attract the men of the proper class for modern men-of-war's-men. Such a lack of consideration for the comfort of men will delay, if it does not prevent, the Americanizing

of the navy. No more ships should be built without flush decks, and all those now finished or building should be decked over without delay. The slight additional weight may reduce the speed $\frac{1}{4}$ to $\frac{1}{2}$ of a knot, but the gain in the efficiency of the navy by such a concession to the men will compensate ten-fold for the trifling loss in speed. In the craze for speed all other elements of efficiency should not be forgotten.

The men need more locker room on board ship. As a rule they have no proper place to keep their rain clothes and rubber boots, and they are usually compelled to lash their peacoats in their hammocks or to stow them in various corners, where they soon get dirty, wrinkled and ragged. A ship's company dressed in peacoats is a sight that gives evidence of shameful neglect. More attention must be given to many of the little things affecting the comfort of the men, if it is desirable to make them contented and fond of the service.

PAY AND PROMOTION.

To secure the second reform—"To raise the standard and develop the type of man required under modern conditions"—there must be an increase of pay, and better opportunities for promotion in the service. Proper promotion will be afforded by making the combatant petty officers the most trusted and responsible men in the discipline and organization of a ship. Permanency in ratings, and the option of retirement after a reasonable continuous service, will keep good men in the navy, ensuring them a proper reward for long and faithful service. No doubt the Board of Organization solved this problem,



about 10 per cent may secure a body of intelligent Americans who will give a far better account of themselves when war comes. It is beneath the dignity of a great nation to hire foreigners to defend its flag, in order to save a few dollars. The United States can afford to employ Americans for that purpose, no matter what it costs.

ORGANIZATION AFLOAT.

The third reform—"To improve the discipline and efficiency by inspiring not only the officers, but also the men with a feeling of personal pride and interest in the service"—may be secured by changes in the organization and training on board ship.

Under a republican government, with voluntary enlistment, it is evident that the navy must compete, to a certain extent, with the trades and civil employments if good men are to be induced to enlist. It must hold out equal opportunities for an honorable career—otherwise good men will refuse to stay in the service. Good discipline must be secured by first appealing to the personal pride and interest of men, and not until such a policy fails should there be a resort to severity and force,—otherwise, foreigners, the lower elements and the slums must be depended upon for recruits. *The navy of the United States cannot be formed of good and trustworthy men until the latter, as well as the officers, are permitted to have the true interest of the service at heart, the same feeling of personal pride, the same hope of permanent and lucrative employment, and the same certainty of reward and proper treatment in return for faithful service.* There is no alternative.

To create this feeling of personal pride and interest among men-of-wars-men should be the constant aim of the service afloat. This policy, as well as the necessity for the military training of sailors, requires the immediate withdrawal of the marines from service on board ship, and the recognition of the fact that the sailor of to-day must be the equal, if not the superior, of the soldier in skill, trustworthiness, and respectability.

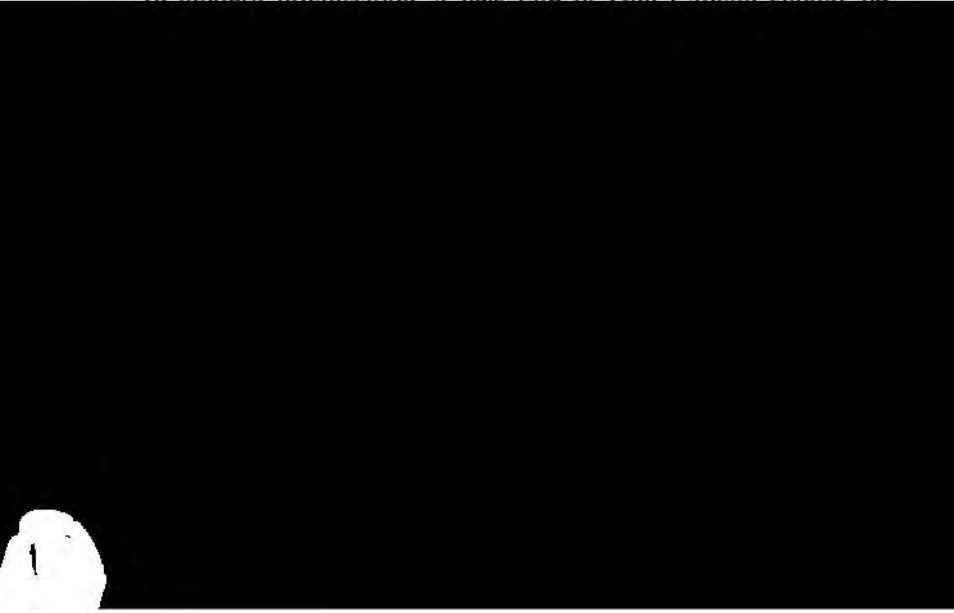
In briefly outlining a system that shall require, above all things, the military development of the man-of-wars-man, the blunt remark of a former messmate—"It is about time that the battery instead of paintwork and sails should form the basis of modern organization"—may be taken as a text. It is a rock upon which to build.

Imagine a modern ship in battle. Surely the intelligent spectator of a naval fight would consider the rapidity and accuracy with which

the great-guns were fired as the governing element of victory. He would look to the patriotism and cool courage of the men who aim the guns as the principal force influencing the result of the fight. Napoleon's maxim—"FIRE IS EVERYTHING, *the rest is of small account,*" is as true at sea as it is on shore. *And yet, in the United States Navy, this maxim is utterly ignored.* The men who pull the lockstrings and upon whom the issue of battle depends are appointed, as a rule, with no regard to military fitness. They are given less pay than the ship's bugler, or the cooks and stewards, and the same as the tailor and the barber. They are not trusted to govern themselves or others, and are regarded as inferior in military matters to the landsman who, as a marine, comes on board ship *for the first time in his life.* It is pure sophistry to attempt a defense of a system so sublimely absurd.

As the gun, the important weapon, should form the basis of modern organization, so the gun-captain should be the leading man in the discipline of a ship's company. The one principle naturally follows the other. The leading men in time of war should be the leading men in time of peace. The men who have the greatest responsibility in battle should not be relegated to a position of inferiority when the fight is over. This is the key to the problem. The petty officer must not be robbed of his just reward. *He must have the same duties in the organization and discipline of a ship that the non-commissioned officer has in the army.* This can never be while the marines remain on board ship. They are an ever present obstacle to the development of the petty officer.

In modern organization, a new rate of Gun Captain should be



this would emphasize the fact that the battery and military elements are always foremost in the modern ship. "Captain of No. 3 gun," instead of "Captain of the maintop," should designate a petty officer.

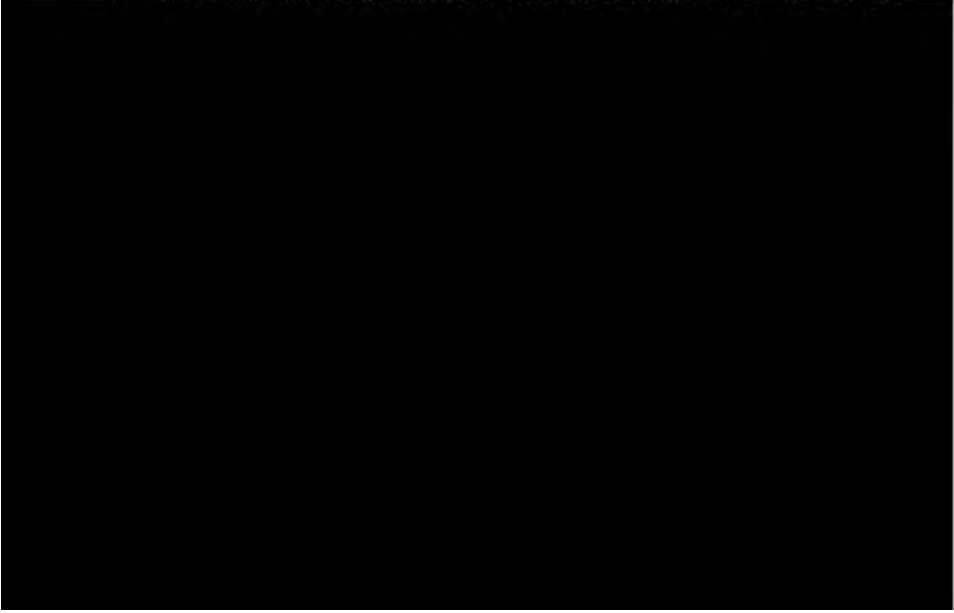
This rank and pay would raise the petty officers of the line to the position they deserve, for are not their duties as important as those of a ship's writer, or a yeoman, or a boilermaker? Every petty officer should be made to assume responsibility and be held accountable for the discipline and good conduct of the men in his part of the ship. He should be the man upon whom to call for assistance in military discipline, and there can be no doubt that with such a staff the officer would find his orders obeyed with greater willingness and alacrity than at present.

The blue-jacket, instead of looking to a non-combatant billet—to the position of a clerk or a yeoman—for promotion and good pay, would soon learn to regard the gun-captain as the most important petty officer in the ship, as in all reason he should be. He would recognize the fact that the man who fires an VIII-inch gun in battle, and who helps to discipline the crew, is quite as respectable as one who serves out soap and tobacco, and, very naturally, he would strive for excellence in seamanship and gunnery as the surest means of obtaining promotion to an honorable office. In short, the calling of a man-of-wars-man would be made sufficiently respectable to attract Americans, and they would not seek to get rid of the blue shirt as the only means of securing a good position in the navy, the only way to be trusted and treated like men. That many who leave the navy now—and the very men we need, too—would remain under a system like this cannot be doubted, and the navy would soon find itself raised in tone and esprit to a patriotic and efficient service. Among the yeomen and appointed officers we now find many excellent men. The rate of gun-captain would be quite as acceptable to men of that class, and other rates in connection with the battery and torpedoes, with good rank and pay, would raise the man-of-war element to its proper place afloat. After twenty years' continuous service, the man-of-wars-man should have the option of retiring on a pension.

The Board appointed to consider the question of new ratings doubtless made all the necessary provisions in this line, but their report has not been published. Since this paper was begun the writer learns that the rate of Gun-captain was proposed by the Board.

The beneficial effect upon the apprentice of such a change in the service cannot be overestimated. He would be brought under a better and more elevating influence. He would regard the petty office as one worth working for, and he would learn how to be a good petty officer—a thing that he does not learn and is not taught to-day. His energy and ambition, his better impulses, would come to the front, and decency and good conduct would receive proper encouragement. The vital importance of this part of the subject must not be forgotten. Instead of losing 90 per cent of the apprentices, a large proportion of them would remain, because the service is not without its attractions to many of them. With all its drawbacks there are undoubted charms and advantages in a naval life, and much that makes it objectionable may be removed with great improvement in discipline and efficiency. The navy can be made as attractive as any trade or employment on shore, and men will gladly choose it for life, if their manliness is recognized and cultivated, if faithfulness is rewarded.

The recruiting stations should play a very important part in the preparatory drill and discipline of the enlisted men. Barracks and strict military routine, and thorough instruction with modern arms, provided for that purpose, should be the rule. Gun-captains should be charged with much of the squad drill and instruction, to accustom the men from the start to being controlled by petty officers. Duty at recruiting stations should be regarded as being of the first importance, otherwise valuable opportunities will be lost. An excellent system is now in operation on board the U. S. R. S. Vermont. Petty officers and seamen are taught to drill the recruits and they do this



obey a petty officer instead of entering into a long argument; he will be more attentive and aspiring, and for this reason it will be far easier to teach him than it is now.

The nautical training of apprentices and seamen need not be neglected. It is not proposed that the instruction in seamanship shall be less thorough. Training ships should be full-rigged as Admirals Porter and Luce declare, because the drill aloft certainly breeds qualities that are invaluable—alertness, fearlessness, and nerve—qualities that cannot be so well secured by any other training or exercise. It may be well to have a training ship on the home coast for seamen and landsmen, where men may be sent from the recruiting stations for instruction in things nautical, in matters pertaining to anchors, chains, hawsers, and wire rope. The English have a ship for this purpose in the Mediterranean.

Until sails disappear entirely from the merchant marine, officers and men in the navy must certainly be taught to handle sails and sailing ships. Every cruising ship should be barque or brig rigged, with light spars and a single suit of sails. In time of peace the necessary instruction may be given to prevent complete ignorance of such matters, and the important advantage of the exercises, physically and professionally, may be secured without undue sacrifice of time. When war comes, the spars and sails may be sent ashore, leaving only the lower masts standing with their military tops. This position regarding sails is a happy mean which will secure, in time of war, all the advantages claimed by the advocates of mastless cruisers, and, in time of peace, all the essential advantages claimed for full-rigged ships. It simply surrenders the idea of using sails as a motive power in time of war.

In all reason, the modern man-of-wars-man should possess, alike, many of the qualities of the sailor and of the soldier. He must know all that the marine knows and much more. To be exact and trustworthy like a soldier or marine, need not make him less skillful with sails, boats, anchors, hawsers and chains; while with guns, torpedoes and explosives he will be more expert, and more to be relied upon. Such a system will attract better men—Americans—who will take more interest in the service if they are made to feel that they form an important part of it, and who will learn seamanship quite as well as the foreigner, or the devil-may-care "Jacky" of the old school.

The seafaring element need not be regarded as the only class from which to recruit modern men-of-wars-men. With proper regard for

comfort, pay, and promotion, recruits may be obtained from the interior who will be quite as efficient afloat, after a little training, as officers are, who come from the same districts. As soon as it is noised abroad that the navy has become an American institution, that it seeks a self-respecting and trustworthy class of men, assuring them an honorable career, there will be no trouble in obtaining desirable recruits.

There need be no difficulty in providing for necessary guard duty in case marines are withdrawn from service on board ship. Ships in the navy have done without marines many a time, and there has been no trouble whatever. Men in the Revenue Marine, the Coast Survey, and the Lighthouse Service prove themselves worthy of trust and responsibility. But the man-of-wars-man is a very dangerous character! He must be suspected, to have good discipline! He is necessarily a lower type of man and cannot be trusted—this seems to be the theory. And yet sailors have served on shore with credit, and have performed military duties faithfully when required to do so by their officers.

Select from each division the men who are to form the guard for the day, with a certain number of petty officers to act as corporals. A line officer should be detailed to take charge of the torpedo and electric plants of each ship, and to him should fall the duties at present performed by the marine officer. The guard should receive his special attention, and he should require at all times the strictest performance of military duties. At the same time he would be available for watch duty and general service in case of emergency. May not a line officer be as efficient as a marine officer in matters of



tions of regulations within such limits. Why should his responsibility be limited to the skillful application of scrubbing brushes, soap, and swabs, to decks and paint-work?

It is absurd to say that "Jacky" cannot be made to do these duties. If the men who now compose the crews of our ships are never to be trusted in anything, they are not the men we want, and there could be no better reason for condemning the system that has brought such men into the service and made them so worthless. Every man who will not do military duties as faithfully as a marine, should be dishonorably discharged from the service at once, and means should be taken to prevent his re-enlistment. As soon as it is understood that the navy will accept none but good men, such men will enlist. As soon as men understand that discharge from the service will inevitably follow military inefficiency, they will do their duty. There may be some friction at first in introducing a system that requires men to be self-respecting and trustworthy. It could hardly be otherwise after insisting for years that the sailor is essentially unreliable. But the service would recover from the shock much sooner than timid people imagine. The navy will be considered desirable by the better elements when it is made too hot for the worthless.

A brother officer has suggested that a partial change in the uniform may influence the bearing of the man-of-wars-man. This is an excellent idea. Perhaps it would be well to do away with the present "mustering suit" and "flat cap," and substitute a suit and cap like those now worn by first-class petty officers. The coat should have a standing collar, and be fitted to the form so that the belt could be worn outside. This uniform should be worn while on guard duty, and upon all full-dress occasions that involve no going aloft. The change would emphasize the fact that modern men-of-wars-men must be soldierly, and there would be a natural tendency for men to brace up and be less slouchy in their bearing. With the exception of this change the present sailor dress may be retained for general service.

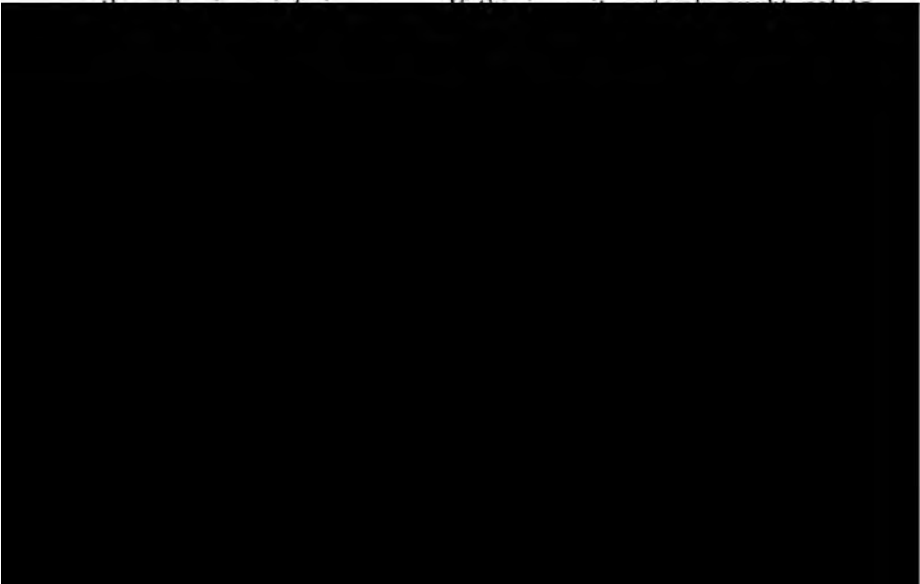
The effect upon the sailor of requiring him to do military duties will be to greatly improve his morals. If his commanding officer will trust him as an orderly, he will prove himself worthy of the trust, and his respect for his superiors will be increased. If petty officers are consulted, as a marine officer consults with sergeants and corporals in matters of discipline, the commissioned officer will find

himself supported at all times by a powerful influence in the midst of the crew. Every petty officer will bring a squad with him to the immediate execution of an order, and there will be a shuffle of feet whenever a command is given.

The standard proposed is not too high. *The higher it is made, the more surely will trustworthy Americans enlist and remain in the navy.* Among 65,000,000 of people the men can be found who will satisfy the requirements of modern men-of-wars-men, and the petty officers will be forthcoming—there are many in the service to-day—who will prove themselves as worthy of the confidence of their superiors as are the non-commissioned officers of an army.

The marine corps is needed for duty at the navy yards and shore stations. If withdrawn from service afloat, the corps would reach even a higher degree of discipline and efficiency than that for which it is justly noted to-day, because battalions would be more permanent, and instruction and drill could be made more thorough and progressive. The corps would be invaluable as a highly trained, homogeneous, and permanently organized body of infantry, ready at all times to embark and co-operate with the navy in service like that at Panama a few years ago. The education of marine officers at Annapolis fits them perfectly for service in connection with the navy. Both the marine and the sailor will be rendered more efficient by such a course.

No reflection is cast upon the marine by advocating his withdrawal from service afloat. *It is simply proposed to stop casting reflections upon the man-of-wars-man,* for it is impossible to dodge the fact that the presence of the marine is equivalent to the charge that



The recommendation of the Board of Organization to withdraw marines from ships of war, recognizing that they stand squarely in the way of the military development of the sailor, is the most important reform affecting the personnel that has ever been proposed, the first and most important step toward improving the tone and efficiency of the service; a reform that takes the most intelligent means of attracting Americans to serve their flag afloat by abolishing a pernicious semi-convict system of discipline, and securing to petty officers and blue-jackets their proper duties and their legitimate rewards on board ship; a reform that will tend to create some national feeling in the navy; that will cultivate the manliness, utilize the intelligence, and win the hearty loyalty of 8000 men, by enabling them to feel that they may have a personal pride and interest in the service, instead of being merely its scapegoats.

And the sailor and petty officer having been assigned their proper places in the organization and routine afloat, the commissioned officer, freed from petty duties that degrade his intellect, will bend his mind and devote his energy to the work that properly belongs to an officer—in short, brains and manhood will have the same chance in the navy as in any other profession, which is not the case to-day.

DISCUSSION.

Commodore JAS. A. GREER, U. S. Navy.—I can only say that I fully agree with the views and suggestions so admirably expressed by the writer.

Lieutenant SEATON SCHROEDER, U. S. Navy.—I am glad to have the opportunity of expressing my cordial approval and endorsement of most of the views advanced by Lieutenant Fullam. There is no doubt in my mind that two of the most serious questions we have to deal with in the service are the presence of the marines on board ship, and the performance by commissioned officers of non-commissioned officers' duties.

The idea of individual responsibility is the one most difficult to inculcate among our petty officers, and the serious fact exists that in that feature they do not come up to the mark. The worst of it is that this is often thoughtlessly attributed to the supposed fact that a sailor naturally cannot be trustworthy like a marine. A remarkable conclusion indeed! Of two men taken from the same social class in civil life, the one is assigned to duty on the police force of the ship, accepts that duty and does it, and does it well, whatever may be his natural proclivities as exhibited when on liberty; the other, who may have

served in many ships and faced many dangers, who may be remarkably expert with helm, oar, marlinspike, and gun, is invariably brought up to believe that in one essential particular he is lacking, viz., in trustworthiness, responsibility, ability to exert authority; and, that fact being so constantly thrust before him, he naturally accepts it, and loses much of his inherent value in consequence.

Our men can be perfectly relied upon to perform the duties they are trained to do. They are good seamen, skillful gunners, and can march, and handle a musket efficiently; but when it comes to assuming responsibility, commanding attention at drill, enforcing obedience, reporting one of a gun's crew for being drunk or out of uniform at inspection, that is not their business, and it never will be their business until they form their own police force. If one of those very men were rated master-at-arms or ship's corporal, then he would probably do his duty well, just because his shipmates are accustomed to the master-at-arms doing that work. If the marine guards were withdrawn from shipboard, and the guard duty devolved upon the several gun-divisions in rotation, they would quickly get accustomed to the new order of things. At the very first there might be some little difficulty—such as always attends any change—but that would not last long, and the good effect of the change would be felt in every feature of naval life.

In expeditions on shore in a hostile country the blue-jackets are perfectly trustworthy when on guard; why should they not be so at other times? There is certainly no reason why the system in vogue in all armies and in some navies should not be equally successful when applied to our navy. It is not at all necessary that the surveillance over a military body should be exercised by men of a different corps and uniform. I can picture to myself the astonishment that our brothers of the army would feel on being told that it had been decided to have at each post one watch of sailors to preserve discipline, search the non-commissioned officers and privates when returning from leave, etc., etc. Yet that would be no more absurd than it is to have marines performing the same duty on board ship.

The essayist is quite right, I think, in laying stress upon the question of



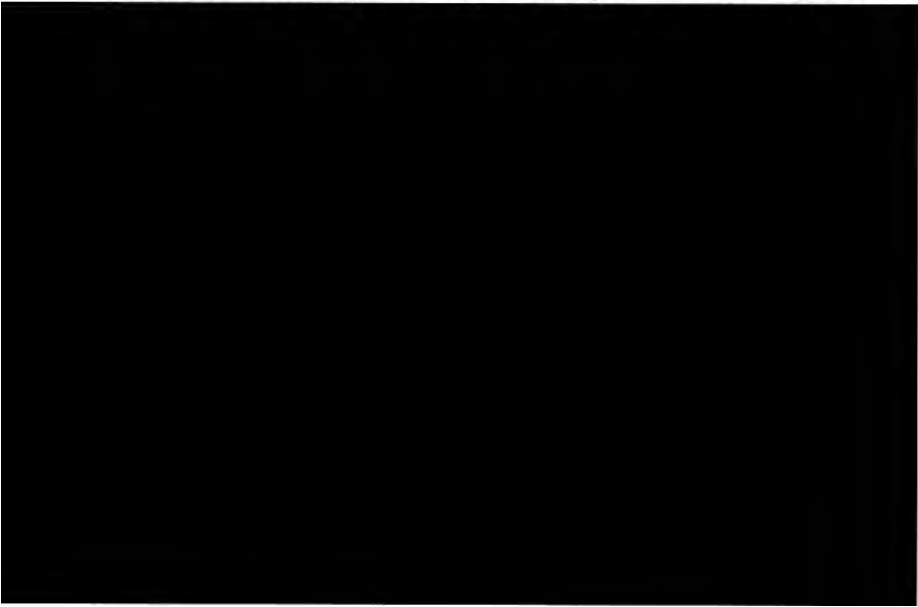
attention to the smallest details. In some ways this is harmful to the officers, but less so than it is to the men. The cadets, on leaving the Academy, are an intelligent and highly-trained body, but must profit by contact with the men forward, I think. With regard to the effect on the men of too much supervision from aft, it is at once one of the causes and one of the results of their not being brought up to think more of themselves; and it cannot be changed until we take steps to imbue them with a higher sense of their own worth and of the power that we wish them to exert. In my opinion, one of the first steps to take to secure this, is to withdraw the marines from service afloat, and to let the men, who are naturally their equals in intelligence and their superiors in attainments, do their own guard duty, and incidentally acquire the power and habit of exercising authority when conferred upon them.

The sailor can do everything that a marine can, and a great many things besides. He now receives just as much instruction with the rifle, has as much small-arm target practice, and is as good a shot. And there the attainments of the marine end. Substitute sailors for marines, man for man, and you would increase by just such a number the number of men on board trained to manœuvre and fight their ships and their boats, and capable of meeting all the emergencies likely to arise afloat.

For fear of being misunderstood, I would like to say that it is not a lack of respect or of admiration for our gallant marines that prompts the emission of the views I have just expressed. I consider them a splendid body of men; the reputation of the corps for steadiness and gallantry under trying circumstances is excellent, and deservedly so. But I think the ship is not the place for them now, except for transportation, like the *Infanterie de Marine* of France, for instance. They not only take up room that could be occupied by men better adapted to service on the sea, but they actually, though innocently, are a stumbling-block in the development of a thoroughly efficient naval personnel.

Ensign A. P. NIBLACK, U. S. Navy.—Lieutenant Fullam has shown up very vigorously a great many of the weak features of our present organization and methods of training and discipline, without in the least overstating the case. With regard to the withdrawal of the marines from service afloat, he has even quite overlooked a most important phase of the argument. The limited berthing space of the new ships necessitates a resort to a most radical reduction in the number of men aboard each ship, and at the same time requires of those she can carry, largely increased intelligence and the ability of each individual to perform a wide range of more or less important duties. Now, the marine of to-day is just what he was thirty years ago, and probably will be thirty years hence, unless the fundamental idea is modified. Either the marine has got to become more of a sailor, or else he must ultimately go. Whether he goes or not, the sailor has to become more of a military element. Of course, if the marine goes, his duties still remain to be performed by some one else, and, unless that some one else is more versatile than the marine, we have gained nothing either in berthing space or in efficiency. If the every-

day enlisted man cannot be trusted to perform the duties now carried on by marines on board ship, then we have the best reason for withdrawing the marines and starting in on first principles to teach and compel the men to perform such duties faithfully. If line officers throw up their hands in fear and horror when such a thing is suggested, it is a good sign that something is fundamentally wrong with their ideas of discipline. A consideration of the laws relating to the Marine Corps will show that no violence is contemplated. Sec. 1616 of the Revised Statutes says, "Marines may be detached for service on board the armed vessels of the United States, and the President may detach and appoint for service in said vessels such of the officers of said corps as he may deem necessary." As a matter of fact, the Marine Corps was organized before the Navy—hence the foregoing. Sec. 1619 says, "The Marine Corps shall be liable to do duty in the forts and garrisons of the United States, on the sea-coast, or any other duty on shore, as the President at his discretion may direct." This really opens up the proper field of usefulness for them, as it would undoubtedly add to the efficiency of our national sea-coast defenses to have them in charge of officers who have had nautical training. The marine is simply no longer necessary on board ship, and it is quite in the line of promotion that this efficient and able corps should be given duties commensurate with their capabilities. We inherited many of our naval traditions from England, and the marine guard on board ship was one of them. In the English service to-day they have two kinds of marines, the "reds" and the "blues"; but the feeling of the necessity for withdrawing them from service afloat is as strong and general as in our own navy. On many, if not all, English men-of-war the ward-room servants belong to the marine guard. The marine is now out of place aboard ship. He takes up too much room, he is not versatile enough, and his presence is the worst kind of a stumbling-block to the military training of the rest of the crew. If these reasons are not conclusive, then the only other thing is to reverse the process and train all our men to be an "improved" type of marine that can paint and coal ship, tar and rattle down, fence, swim, pull an oar, sail a boat, pass a weather-easing, steer



contemplated that when a man qualifies hereafter he shall require excellence in marksmanship to get his certificate. It would be a wise plan to have a board organized temporarily to draw up an improved plan of instruction for seaman-gunners, with a view to uniformity in future requirements and requalification of those now in the service. The Chiefs of Bureaus of Navigation and Ordnance, the Commandant of the Washington Navy-yard, and commanding officers of Dale and Torpedo Station would certainly be able to outline and carry out a definite and uniform system of instruction and promotion for seaman-gunners. Just now it is not at all uniform.

New watch, quarter, and station bills are needed for our new types of ships. "Coal is king," and with twin screws it is idle to talk of sail-power except for storm purposes. The gun, the ammunition-whip, and the coal-bunker should be the basis of our new organization. Abolish parts of the ship, and have three gun-divisions, embracing 45 per cent of the crew. Have no special duty men whatever taken from the gun-divisions. The engineer's force, with twin screws, requires on an average 25 per cent of the crew. From the remaining 30 per cent, with the assistance of as many of the engineer's force as are needed and can be spared, organize the powder and navigator divisions. This 30 per cent would include petty officers and idlers, messmen, watch petty officers' orderlies, sentries, side cleaners, messenger boys, the mail carrier, steam launch and dingy's crew. (This assumes that the marine guard is withdrawn.) In special ships it might be found desirable to increase or decrease the 30 per cent at the expense or gain of the gun-divisions, but the point here aimed at is to do away with all this excusing men for special duty out of running boats and from the guns' crews. Make a gun's crew a boat's crew for "arm and away" and for running boat. The powder division is the disorganizing factor in our present organization, and its importance is hard to overestimate. With the numerous chains of supplies for all sorts of guns that fire ammunition so rapidly, with the numerous water-tight doors on and below the protective deck to be looked out for, numerous pumps to man in case of fire or accident, with the care of the wounded sent down from the decks above, and with the scattered forces of such a large division to keep in hand, we have some very difficult problems to work out. The only satisfactory solution is to wipe out our present type of watch, quarter, and station bill and begin all over. Lack of space forbids the attempt to outline even what we should have in our new ships.

The next few years will see some changes and improvements in the character of the personnel of our crews, and it behooves every one to awake to a realization that new ships mean enormously increased responsibilities on the part of the officers. It is worth an earnest effort to try and attract and help keep in the service the best class of Americans possible. Lieutenant Fullam has hit so many nails squarely on the head that it is only possible, without going into details, to endorse briefly all that he has said. In his service on the Boston, Vesuvius, Yorktown, and Chicago, he has evidently done some thinking, and time will demonstrate that unless more thought and good-will is shown in the improvement of the status of our enlisted men, we can never hope to have a navy that will merit the respect and confidence of the American people.

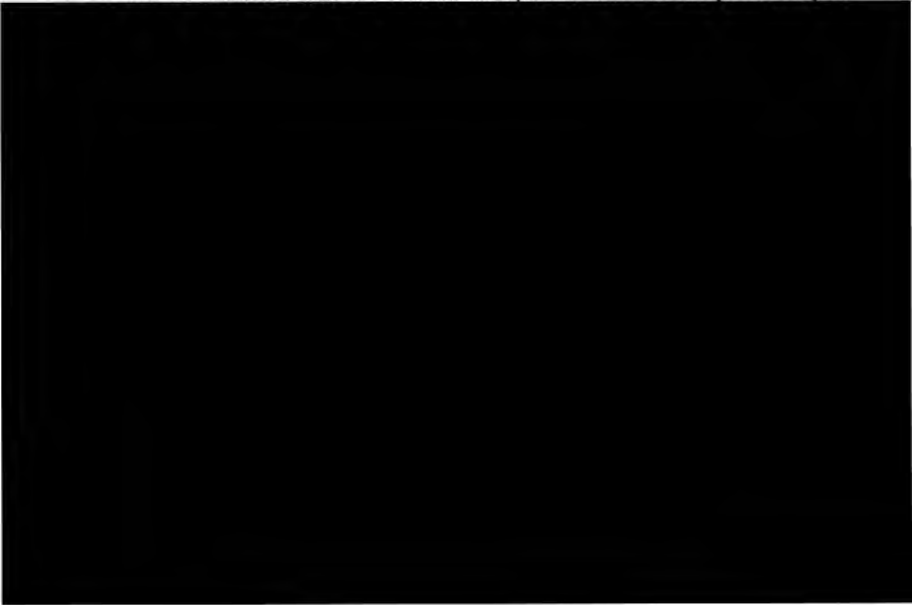
Lieutenant C. E. COLAHAN, U. S. Navy.—I have read with great interest the paper written by Lieut. Fullam, on the system of naval training and discipline required to promote efficiency in the navy, and do earnestly endorse and approve the general argument contained therein.

There is, in my opinion, a lamentable neglect in the present system, in not making the position of the petty officer on board ship one of responsibility and importance. The pay of the petty officers of the higher grades, especially those of the line, is clearly inadequate.

The chief petty officers of a vessel of war, and those receiving the highest pay, should be the leading men in the gun-divisions, those who are proficient in all drills and capable of instructing recruits; they should be held responsible for the improvement of those instructed. These petty officers might be styled Division Mates, which rate should replace that of Boatswain's Mate; then would follow the Gun Captains, the grades thus being given the military titles instead of the old titles, which in the modern ship have no significance. These men should have the care of the deck, bright-work, etc., in the vicinity of their guns, as well as of the guns themselves; they should be held to a strict responsibility for the proper keeping of the same. The officer of the watch is now held personally responsible for innumerable petty routine matters that should properly belong to the petty officer; they should not be upon the mind of the officer of the deck at all.

In regard to the presence of the marine guard on board ship, I have merely to say that there is no room for them. The Marine Corps is a remarkably well disciplined and a very efficient corps; so also is the 1st regiment of U. S. cavalry, but neither of them has a place on board a man-of-war, which should have a homogeneous crew of the seaman-military class, each member of which could be called upon for all duties: for that of the service of the guns, that of the sentry on post, or those duties in connection with the sails, anchors, boats, etc. We cannot give room on board ship to a number of men having circumscribed duties only.

It will be admitted that the seaman has quite attained to the proficiency of



the ship is designed for fighting and for no other purpose is logical and to the point. The *personnel* is a tool to this end that can be no more neglected than can the *matériel*. It is undoubtedly true that the lack of efficiency of men now found in the service is due to the survival of methods which in their day were admirable but which cannot now be utilized. All energies lately have been turned to building up a navy. It is only when results begin to appear that it is discovered that the organization and methods of the steam sailing ships are no longer applicable. The present condition of affairs is clearly shown in the paper. It is totally unsatisfactory. To devise improvements is to reorganize the navy. Mr. Fullam has certainly advanced many practicable and desirable changes. I do not know that I agree with him in putting the disembarking of the marines in the first place. That their influence on shipboard is harmful there can be no doubt, and that it would still be harmful if the seamen were trained to the highest point of military excellence is also probably true. At the same time I believe that there are methods of raising the tone, *morale*, and military efficiency of the blue-jacket which would produce greater results than simply sending the marines ashore. Therefore I put these methods, many of which Mr. Fullam discusses, in the first place, though I agree with him that the ship would be better off at the same time without the marines.

I think I understand the word "military" in a little different sense than that used by Mr. Fullam. He starts by saying that "all other than *military* elements have been reduced to a minimum in naval warfare and in naval architecture," and later that "the strictly *military* duties on board ship are performed by the marines. Here we come to the real cause, direct and indirect, for the absence of *military* instincts among men-of-wars-men—the fact that a company of soldiers is placed on board ship to do the *military* duties, to watch and search and discipline the sailor." The italics are mine. Now, if all the elements of naval warfare are to consist in such military duties as the marines perform on board ship, we shall not progress very far. The inconsistency would be removed by substituting "guard and sentry" for "military" where it relates to marines, though I am afraid it would destroy the point. Guard and sentry duty is not the best means for teaching men to be military, and by *military* I mean attentive to duty, disciplined, and exact in handling all the weapons with which the ship is provided. It is in frequent and progressive drills with these weapons that military efficiency is best promoted. Guard and sentry duty is good, to be sure; but I should like to see the marines done away with afloat, more on account of the injurious effect on the *morale* of the sailor element that their presence as a police force exerts. If they are not needed as guards and sentries, there is evidently no reason, as Mr. Fullam very clearly shows, for retaining them on board ship.

In regard to improving the quarters of the men, Mr. Fullam's suggestion of flush spar decks is a good one. The plan is being followed extensively abroad, and will be followed perhaps in our Bennington. I do not believe the open decks are the sole cause of discomfort in the ships named. In the Yorktown, which is the only one of them with which I am familiar, one great trouble seemed to be that the officers as a whole occupied a very large share of the available space. They

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were more numerous by a third or a half than in foreign ships of a similar type. When by the necessities of the service the complement of officers has been materially reduced, it would seem that a more economical arrangement could be made by a combination of the messes, thus rendering more space available for the men, and at the same time reducing the non-combatant servant element. It is probable that all or nearly all the officers required for the Yorktown class could find comfortable quarters under the long poop. The space surrendered below would be given to the crew. In the French cruiser *Forbin*, of the same size and total complement, there were ten officers to fifteen in the Yorktown; they were all quartered under the poop, and the whole of the lower deck was given up to the men. An arrangement of this sort would remedy much of the discomfort that Mr. Fullam mentions. The changes now in progress in the Yorktown are in this direction.

I concur in all the other suggestions for promoting discipline and efficiency, and for attracting a suitable class to the service. It is to be regretted that the writer did not go farther in a plan of drills and interior organization that would promote the same end. The main ideas to inculcate are, that the ship is a fighting machine, and that duties tending to increase her efficiency as such must take precedence of everything else: the buoyancy, *morale*, spirit of the whole *personnel* must be raised; duties that exert a repressive influence should cease; responsibility should be more extended; and lastly, the health, comfort, and happiness of officers and men should be zealously sought.

Lieutenant-Commander E. H. C. LEUTZÉ, U. S. Navy.—Having only a limited amount of spare time, but feeling very strongly on this subject, I would like, if possible, to aid this "good cause" by a few words. I thoroughly agree with the author in everything he says in regard to the blue-jackets and marines. The latter are not only not needed on board of a modern vessel of war, but are doing a positive harm, their presence tending to drive self-respecting men from the service, or, in other words, the class of Americans that we need and must have. The blue-jackets are the men who should be fostered,



men, and the conditions of life be made comfortable and self-respecting for them. The career, to my mind, must relate to the gun, and Lieutenant Fullam strikes a key-note when he says, "the men to man such ships should be, pre-eminently, naval gunners—not sailors of the old school." The gun and torpedo, in other words, the military instruments of offense and defense, must become before long the basis of our naval organization; and with that change will necessarily come a change in ratings that will carry with it the abolition of many of them, time-honored but now obsolete. Warships are built primarily to carry guns, and the absurdity of organizing their crews on any other basis than the gun is so evident that I cannot believe our present system will survive much longer. Very few petty officers should have better pay than the captain of a main battery gun or a torpedo-tube. We must have the *best* men we can find for and in these billets; but it is idle to expect the best men in ratings inferior in pay and position to a large number of other ratings in the ship's organization. Right here is the possibility of creating an attractive career for our enlisted men. Let the ratings be given and named, as far as possible, in relation to the weapons of the ship, and let the gun-captain hold a rating not to be secured without effort, but permanent under proper conditions when once attained, and carrying with it responsibility, position, and sufficient pay to retain good men. Fifty dollars per month, or even more, if found necessary, would not be exorbitant. It will be wise economy in peace, and wise insurance against war, to have a trained body of gunners who will make every shot tell. We can't afford to be without them; the fire of modern guns is too expensive, and the supply of ammunition on shipboard too limited. The adoption of such a scheme would, I firmly believe, by opening up a considerable number of attractive billets, serve to keep a far larger proportion of apprentices in the service than at present. As Lieutenant Fullam observes, they form now by far the most intelligent part of our crews, and every means should be adopted to hold them, especially if such measures conduce to efficiency. But, in addition, if we are to get and keep the class of men we want, better provision for their comfort must be made. Their quarters on many of the new ships are painfully inadequate, and the present system of messing abominably bad. Every man should have a comfortable billet, without the necessity of having somebody slinging above or below him. Petty officers should berth and mess apart, both for their better comfort and as a matter of discipline, to make their position more marked. Certain ones, whose duties are especially arduous, should have state-rooms or quarters somewhat similar to those occupied by the junior officers, where they can sleep in peace after "all hands" in the morning, or during the day when off watch. Wet weather clothing is prescribed, not permitted, and yet no place is ordinarily provided. To provide for these matters in the ships already built would doubtless be difficult, but they should be looked to in all new constructions.

The measures mentioned above would, I am convinced, promote discipline and efficiency, apart from the fact that they would operate to bring in and keep a better class of men in the service. With the separation of the petty officers from the remainder of the crew, and with a greater difference than now between

their position and pay and those of the rank and file, the former's self-respect and manliness will be fostered, their control of those under their supervision and authority be increased, and they will be in touch with the commissioned officers in matters of discipline, which, unfortunately, is not often the case at present. On the other hand, the commissioned officer will hold the petty officer in higher estimation, and look to him for more assistance in proportion as his position is magnified. More responsibility should be given the petty officer, and he should be held vastly more accountable than now for the proper performance of duty by his subordinates. In this matter the commissioned officers are at fault to a very great extent, and the remedy is as largely in their own hands. The petty officer cannot hold his office in great esteem when his seniors treat him merely as one of the crew, give him little or no responsibility, hold him to little or no accountability, and give him only the slightest backing in his proper exercise of authority.

When the Board of Organization recommended the abolition of the Marine Corps, as far as sea-going duties are concerned, I confess that I was opposed to the step. But a more careful consideration has led me to see the wisdom of their decision. Now that every combatant on board ship is taught to use his rifle, marines are not needed as sharpshooters. I have served in one ship where there were no marines, and orderly duty was done by the sailors, to the entire satisfaction of everybody, as far as I know. I have also seen a quarter-deck guard of blue-jackets render honors quite as acceptably as the marines, barring the absence of the drum. Really, then, there is no apparent reason for this retention except to do guard duty. The army has no distinctive corps for that purpose, and I am unwilling to admit that the men of the navy are worse disposed than those of the sister service. Thus there seems no *necessity* for marines on board ship; and if the bad effect of their presence on the rest of the crew, so earnestly and fully described by Lieutenant Fullam, be conceded, there are slight reasons for, and very urgent reasons against, their retention. I believe this bad effect does exist, though not perhaps quite to the extent that the lecturer thinks. Therefore, being convinced on this point, and feeling



It is an excellent indication of the tone of the service when a junior officer (one of those, who, in personally supervising every petty detail of the work aboard ship, are closest to and best acquainted with the character of the blue-jacket of to-day) announces that he is as capable of policing himself as any soldier could be.

Undoubtedly, if the Marine Corps is dispensed with, there must be a wiser, firmer, and more watchful control exercised by the officers than is now necessary. But, on the other hand, what a commentary on the wisdom, firmness, and energy of the officers of the navy, the present duty of the Marine Corps affords!

The presence of the marines on shipboard is almost as un-American as would be the control, by troops, of citizens already provided with their legal and efficient authorities; for our ships are efficiently officered. No better amendment to the act prohibiting the enlistment of aliens could be made than one providing that American sailors should constitute their own police, and formulate their own pattern of military excellence on the sea.

When navies were manned by force, and governed by bloodshed and brutality, in the days of the press-gang and cat, then there may have been need of a special corps to carry harsh rules into effect, and protect the authorities against men wronged to desperation. Does the blue-jacket of to-day obey simply through fear of the marine guard? Does he respect his officers the more because they trust their own authority and governing power the less? The blue-jacket is to-day robbed of quarters, military training, pride and honor, by the Marine Corps. Is it a wonder that he so rarely exhibits spontaneous patriotism?

I am sorry that the essayist has expressed himself in favor of retaining sails and spars "for exercise," especially as it seems inconsistent with his previous remarks concerning routine exercises. The handling of sails and spars, from the creation of the navy, has formed the very foundation of routine; it is improbable, should they be retained, that they will not continue to occupy a more prominent position than their merits for exercise warrant; neither is it probable that a reorganization scheme, having improved service and fighting efficiency for its objects, will be promoted by the continuance of obsolete elements upon which the present organization was founded. With regard to our present routine drills, some are provisional and new; the rest retain almost all the features that have been added during the past one hundred years, however inappropriate they may be at present; nevertheless they are excused because "they exercise the crew." No wonder that the sailor-man becomes restless on drill, when day after day he must play a part in so dreary a farce. The worst feature of it is that there is nothing in the drill to indicate what is real and what is farcical; sometimes the two qualities are hopelessly confused. No wonder these drills lack snap when the incentives of purpose and competition are alike absent.

If it is the sincere intention to devote a certain time to the physical culture of the crew, let the matter be handled systematically, keeping that purpose to the front. Let boxing, wrestling, and fencing masters take the men in hand. Without the accompaniments of storm and urgent need (and these would hardly affect "light spars for exercise"), work aloft will no more develop nerve

and courage than traveling on the elevated railway or over the Brooklyn Bridge, though doubtless many have felt trepidation while undergoing this experience for the first time.

The new navy is not a vague possibility. It is here. But unfortunately it lacks a *personnel* benefited by the experience that would have led to its natural and progressive development. Turn in many directions and we are confronted by misfits. Both organization and drill need a radical overhauling, though the confusion of change and condemnation of old standards apparently leads to such demoralization as to bring about a sturdy resistance from some of the most conservative officers in the service. In this connection it may be said that the service cannot help but be conservative, as three-fourths of the officers are ten years longer engaged in subordinate duties than they would be with a steady and regular promotion. The ships are new; the officers are ten years older than they should be to perform their duties to the best advantage.

Lieutenant W. L. RODGERS, U. S. Navy. — agree heartily with almost all that Mr. Fullam says.

The navy is largely filled with foreigners, who ship only to send their wages to Europe; and when our apprentice-boys leave the training-ships they find themselves in a foreign atmosphere to which they are unaccustomed.

Further, the present system of messing (which satisfies our present navy, composed of what a politician would call the "pauper labor of Europe") is simply disgusting to American-bred boys, and it is no wonder they cannot be retained in the service. The remedy for this state of affairs appears to be in the adoption of the Alien Enlistment Act and an entire change in the mess.

I think it would be practicable to put the men's mess on substantially the same basis as the ward-room mess. The ship should have a large space divided off as a pantry, and this would require much less room than at present, the whole berth-deck being occupied as a kitchen all day long. All the rations could be commuted, and supplies drawn from the paymaster's stores or purchased on shore, as convenient. An officer should have the general supervision



quarters to commanding officers. The *Boston* and *Atlanta* are the only ships that I know of where the cabins are of moderate size in proportion to the ship. Consider, for instance, the advantages that the changes just announced in the *Bennington* will give her over the *Yorktown*. With a flush deck, the ward-room will doubtless be put on the main deck and the cabin be much reduced in size. Ships of the *Bennington*'s size need no junior officers. The present ward-room and junior officers' quarters should be assigned to the petty officers as their quarters and mess-room. The principal petty officers should be given state-rooms or alcoves, two men in each room. Storekeepers now make it a general practice to sleep in their store-rooms; this custom should be maintained, as the ventilation is very good. If all cruisers were to have such accommodation for the crew as the *Bennington*, ships would be comfortable homes, and much more desirable men would enlist. Another great amelioration would be to have a table *always* spread with cold dishes for the engineer's force. This is the rule in the merchant service, and is much missed in the navy by all concerned.

Marines have no longer a function on board ship that can be filled by them alone. No doubt, were the marine guard removed from a ship, there would be some trouble for a little while, but only such as a man recovering from lameness might experience when he first throws away his crutch. On board the coast-survey and small ships in the navy, marine guards are found unnecessary; so there seems no reason for retaining them on the large vessels. This is tacitly acknowledged by marine officers themselves when they express a desire to have the secondary battery, etc., turned over to the marines; for, if they now have their well-defined place in the ship's organization, why should they wish for more? If the marines are not a necessity on board ship, the disadvantages of a double organization and system of discipline, where men cannot be transferred as convenience demands, are perfectly obvious.

Finally, I come to the only point in which I disagree with Mr. Fullam, namely, in regard to sail-power on our new ships. In a single-screw ship, sail-power is necessary as a reserve motor in case of accident to the primary motive power. But in twin-screw ships, one engine is the reserve of the other, and I see no more reason for embarrassing such ships with sail-power as a second reserve motor than I do for putting sweeps on board a single-screw ship as her second reserve. As for sail-power enabling ships to keep their coal on hand, we must recollect that in making a passage under sail at low speed the consumption of coal for lighting, distilling, etc., will be a large proportion of what would be required to make the same passage under steam at a higher speed, and also that the coal endurance of a large ship is quite equal to her provision endurance, and that provisions as well as coal have been declared contraband of war by the French.

No doubt, as Mr. Fullam says, officers and men should know how to sail ships in order to take charge of their prizes; also, the handling of sailing ships cultivates a certain nerve and resource, but this could be acquired in special sailing-ships such as the English "*Cruiser*," attached to the Mediterranean squadron, which takes drafts of men from the mastless ships for three months' instruction under sail and then returns them to their old ships.

In conclusion, I would like to repeat that what seems to me most needed to raise the quality of our enlisted men are improvements in their condition and increase of comfort on board ship, and to point out that an amount of money annually expended on increasing the pay of the navy would produce no result whatever; if spent on increasing somewhat the displacement of ships building, so as to give better quarters to the crew, it would probably produce very marked benefits to the service.

Lieutenant J. F. MEIGS, U. S. Navy.—I think that naval officers are, as a rule, in agreement with Lieutenant Fullam as to the necessity for a change in the method of recruiting and training our enlisted men. To retain Americans in the navy we must hold out to them advantages which, at least, approximate to those found in other occupations. The matter of training them will, perhaps, follow easily when we have devised a method by which to get and keep them. When we come to examine the exact steps necessary for this, a considerable diversity of opinion will be found to exist, though as to the nature of these steps there is substantial agreement that an advance of pay and a general betterment of position are necessary. It is my belief that Congress will give us the additional amount of money required to pay certain ratings more, as soon as we have decided what those ratings and their duties shall be, and that the betterment of their condition lies almost wholly within our present power. I may mention that it is my opinion that the creation of a rate of *gun captain*, in the manner suggested by Lieutenant Fullam, would be well received by officers generally. Other, and in some cases similar, changes would follow naturally. It is not strange that we should be unable to agree as to exactly what we want in these matters; that will come as the issue of the publication by the Naval Institute of such excellent papers as that of Lieutenant Fullam.

Lieutenant-Commander C. S. SPERRY, U. S. Navy.—In the days of sails, the training of the crew in handling them was of vital importance. In a



Rank and pay commensurate with their importance, and that is second to none, should be given to petty officers exercising military control over men.

As for the presence of the marine guard on board a vessel of war, I fail to see that it degrades the position of the sailor.

Indiscriminate overhauling and searching of the person would be none the less humiliating, as customs go, if done by a blue-jacket police. The question is : shall a vessel with a complement of two hundred men have thirty men on board whose *general* usefulness is very limited, and is usually extended by making them do the work at the battery of the sailor-men whom they crowd out of the complement? Or shall we have thirty able-bodied general service men who can be taught to shoot as straight as a marine, and at the same time consider it their natural mission to work a gun, handle a sail, or go in a boat?

It is doubtful if we can undertake to give in the service the wages that a good, capable American citizen can earn on shore ; but there are possible compensations. Under a liberal system of continuous-service enlistments and retiring pensions, his income, though small, would be secure. As a well-paid, trusted, and responsible petty officer, to be disgraced only by sentence of a court-martial, his position would probably be quite equal in dignity to any he is likely to attain on shore, and in many ways would be very attractive.

Quarters should be good, even if a light upper deck must go on, pay and clothes good, and the tenure of rates secure. But all of this is of no use if we wish to keep in the service the Americans whom we shall long for in the day of battle and danger, unless the positions to which they are advanced carry with them real, active *responsibility*.

We all know what kind of shipmates some of the best of our countrymen make when they have little to do and no responsibility—and how they stand behind one when things look black.

We have many fine men now whom we are always glad to shake by the hand as old shipmates. Let us hope we may get more and keep them.

Lieutenant J. C. COLWELL, U. S. Navy.—It is not washing our dirty linen in public to try to improve the personnel of the navy by telling the truth. The American public is neither blind nor collectively fools ; but it is spending many millions of dollars each year with the object of having a navy, and it wants results. It cares nothing about our hobbies. It wants the full value for money expended ; and when some day it takes it into its head to investigate for itself, the service optimist who proclaims himself satisfied with the present efficiency of officers and crews will find that he has not lightened the weight of the hand that will surely fall.

I believe Lieutenant Fullam has done a great service by speaking out in meeting and saying what he believes about the inefficiency of our present system of organization and training. At least it will cause discussion.

Radical changes are what the navy needs, and radical changes will be made for us before many years, unless we indicate those needs and so have a voice in the making. The personnel surely should receive as much attention to develop it as does the matériel. The enlisted man, as we find him in the draft-

that come to us, is the person we have to work with, not some theoretical sailor-man who does not make his appearance. His origin is what we must first consider. With a proper organization and a consistent system of discipline, we can form his habits, control his character, and make his training what we choose. If he be a seaman, the chances are that he has been brought up in a merchant ship hailing from some port in the north of Europe where work is hard and pay poor, and he sees that if he does fairly well the work to which he has been accustomed, about the decks or aloft, his pay will be raised and he will be rated a petty officer. The distinction is not valued, but the additional American dollars are, and he devotes himself to being a more or less efficient care-taker of the decks and rigging. He cares nothing for the drills, because he sees other men, like himself, given a rating when they do not understand the difference between a 6-inch and a 6-pdr. gun, and cannot read the figures on the sights of their rifles. He expects to receive his reward in due course. He has no pride in the service because he is there for dollars only, and values the service because he is paid more of them for fewer and less valuable qualifications than he would receive in any other seafaring occupation in the world. If he be an ordinary seaman, apprentice, or landsman, he is listless at drills because it is not made an object to him to be anything else. He sees the honors bestowed for reasons that ignore the existence of guns on the ship. He takes no pride in the service because he finds placed over him men who do not value the honor beyond the extra pay it brings, and for whom, if he be intelligent, he can have no possible official respect. It results that the officers have to devote much of their attention to doing the duties of petty officers, who think that they are giving a full return for pay received if they man the brooms when sweepers are piped, or answer in person a call for a hand from their part of the ship.

The native element that comes to us is good enough for all the petty offices we have to bestow, if it is taught to think so, and this element will rise to the requirements in a surprisingly short time. I have known a young American, on his first enlistment drawing a landsman's pay, after six months' drill and



To attract the class of men we need, we must show that we are prepared to recognize and reward by advancement, brains, zeal, and good conduct, just as those qualities are recognized in the labor market of our country. Under our present system, a young American with the sea instinct, and possessing all those qualities, but who is unfortunate enough to enlist as a landsman, finds himself in a veritable slough of despond. His brains are unrecognized, his zeal is mistaken, and his good conduct serves but to get him on the liberty list. I have known several such who ended an enlistment in the rate they commenced—still landsmen after three years' good service, with no recognition of any qualities beyond those exhibited as permanent sweeper or berth-deck cook. These men, who had the making of first-class men-of-war's men in them, had they been properly encouraged and advanced, saw one foreigner after another, inferior to themselves in every desirable quality, advanced to petty-officer's rank simply because the talismanic word "seaman" appeared after their names on the muster-rolls, a title that means nothing as to the man-of-war efficiency of the possessor. Young men of that type should be given every encouragement to improve their technical knowledge and to stay with us; but rarely do they serve out an enlistment, and when they do, it is to leave the service with a well-grounded disgust, and to disseminate a dislike for it among the very people we should attract. The apprentices feel the same discouragements. Vastly inferior men may be, and are, placed over them as petty officers, because the seaman-apprentice is too small, or too young, or hasn't been at sea long enough; and then we solemnly stultify ourselves by making the same young seaman a gun captain, and stationing the captain of his part of the ship at the same gun—a military anomaly and a direct blow at discipline. But the apprentice was intelligent and could handle his gun admirably, while it was beyond the understanding of his petty officer. It is safe to say that that young man will not be a good recruiting agent when he drops a service that opens no career to his seamanlike qualities of the best kind. Or, again, when he finds all the prizes of the enlisted force in the way of pay, position, uniform, and consideration bestowed upon the non-combatant element, it is not likely that he will feel kindly towards a navy that ignores his value as a skillful fighting factor. He finds his contemporaries of sedentary tendencies advanced to positions of trust, and put in the way of ratings to writers, yeomen, and clerks, though they may know little about ship or gun and care nothing. *He* had the sea instinct or he would not have come to us; he developed it, and we ought to repay him with the best prizes of pay and position; but we do nothing, and he goes, while the clerk remains with us as the result of that effort to Americanize the navy.

The crews that we have fall very far short of meeting modern requirements, and it is owing to their lack of systematic, consistent, military training. They are not *required* to be attentive, careful, and thoughtful in military drills; they are required to be all this in caring for ship, boat and top. They are told military drills are important, but they see the rewards of service, the petty offices, going, not to the man skillful with the great gun and rifle, who attentively listens to, and intelligently grasps, the instructions of his officers on

drill, but to the man who has a reputation for being a good seaman, which means with us not what it ought to mean in a navy fast becoming sailless; or to the man who toils painfully over paint and ladders, or spends hours polishing up a cutter, which, likely as not, is then forbidden to be used except on show occasions, for fear of its being soiled.

How many of our present petty officers could be safely drafted to a volunteer organization, or ship, as instructors, to form a trained nucleus around which the men fresh from civil pursuits could rally and look up to as models to imitate?

The gap between the men and the petty officer, not as he is, but as he ought to be, must be made greater, and between the latter and the commissioned officer, less. Better quarters and better pay for the fighting petty officers, and permanency of rank beyond the chances of a change of ship or of commanding officer, will do much to attract and hold the men needed.

A man-of-war that is "kept like a yacht," as we occasionally hear, is a very attractive spectacle, but that is not the end for which we are maintained by the nation. Nobody will care when we go into action whether our ships look like yachts or like coal-barges. The only solicitude will be for military results; and we are not training our crews to the end required of us. The good "seaman" (and good at nothing else) has an entirely fictitious and mainly sentimental value in these days. He was of prime importance when the captain who could most quickly manœuvre his ship, handle his sails, and repair damages aloft, was thus able to place and keep his battery in its best tactical position. He is no longer needed for that purpose. A couple of men in the conning-tower place the battery where desired, and it is the battery that wins or loses the fight, according as the crew is skilled or unskilled in its manipulation. Individual skill, here and there, we have, in spite of discouragements; organized general skill, with the best men in the most important places, holding rank and drawing increased pay by virtue of that skill, is what we need. A petty officer made gun captain by virtue of his rank, who can neither shoot straight, handle his gun properly, nor drill a squad, is a very



possession of responsible authority over those whom he himself has demonstrated to be his professional inferiors.

I quite agree with Lieutenant Fullam as to the desirability of dispensing with the marines on board ship, though I do not believe that it is the first nor the most important move to be made in an effort to improve the *morale* of our crews. The day of the marines passes with that of the old-style seaman, and we no longer need them. As a part of the fighting force of a ship they are gradually becoming an embarrassment. On one ship we find them scattered at the guns, filling subordinate stations; on another, assigned to man the secondary battery, and on another, drawn up in line to be used as sharpshooters when opportunity offers, meanwhile to be shot at and killed by rapid-fire and machine guns at distances beyond the effective range of their rifles. Each of these is a waste of good material, and a poor use to make of the training of a crack corps.

With a crew organized on the battery basis, it would be a simple matter to mount each morning a guard of one or as many gun-crews as might be needed to furnish the sentries and orderlies for the succeeding twenty-four hours. The moral effect on the crew would undoubtedly be great. There would be visible to them independent, responsible command exercised by members of their own body, the petty officers knowing their duties and trusted to perform them, respected by their superiors and obeyed by their inferiors—an object lesson in discipline that could not fail to make its effects visible in every variety of ship's duties.

The officers of subordinate rank feel discouragements of a somewhat similar nature to those indicated for the men. It does not require much brains to see that the rewards go to those who have "sought the beach." Naturally other men go there. If they have brains, they find them recognized, and duty assigned commensurately. On shipboard, the only measure of ability is the inches of gold braid on the cuff, and the only qualification for increasing the measurement is the elapsed time since the uniform was first put on, an interval during which many brains of original promise rust out, or, discouraged, fall into the rut of routine. Routine is not the end, nor is what we call discipline, nor yet is a ship polished into a thing of beauty. They are but means to the end—FIGHTING EFFICIENCY—and unless we attain that end, all the rest is wasted time and labor. If we attain it now, it is in spite of our organization and system of training, not by reason of them.

Our crews should be trained with the tools that they are to use in war. Yards and sails are no longer those tools. The guns, torpedoes, electric plant, signals, boats, wheel, lead, engines and boilers, *are*. There is plenty of scope. Oars, single-sticks, and a gymnasium outfit will provide additional physical training. The latter is seen in perfection and daily use in the French navy, and is being developed in the Italian navy. I am also informed that it is successfully used in the German navy.

Sailing ships no longer carry the bulk of the world's commerce. In time of war they would disappear from the trade routes. Why, then, should our men be organized on the basis of their ability to handle what the navy will never

require them to use, and why should time be wasted in teaching them an obsolete naval art? There will be no more sailing prizes brought into port. The cruiser costing from \$700,000 to \$3,000,000 cannot afford to detach officers and men for prize-crews. Burn, sink, and destroy (excepting, of course, neutral vessels) will be the orders of cruisers in the next naval war, and the only exceptions will be in the case of prizes of value sufficient to warrant a convoy; such prizes can be found only in the great steam-liners which are practically sailless.

Sails for war use have gone out of date; the old-style seaman, the unit of organization in days past, must also go. But a higher type of seaman must take his place, and how to produce him and retain him is the problem that is set us to solve. According to our solution shall we be judged by the people, in the day of trial, and sentiment will not enter into the judgment.

Commander HENRY GLASS, U. S. Navy.—The paper which has just been read calls attention to the existing need of a more thoroughly military organization for our vessels of war than we now possess, and I think this a need which should receive the careful consideration of all officers of the navy. I am in entire accord with most of the ideas advanced by the writer, and with the suggestions for changes in the rating and pay of enlisted men, and for increasing the inducements offered to induce valuable men to remain in the service, all of which I advocated some years since in a paper written for the Institute.

The present organization of the crews of our vessels grew out of the needs of the sailing ship; and while it was perfectly suited to a frigate or sloop-of-war, even in the days of auxiliary steam-power, it has, unfortunately, been retained in the service long after the vessels for which it was intended have become obsolete. What is needed at present is an organization appropriate to the modern battle-ship and fast cruiser and the duties to be performed on board them, and such an organization should be devised and put into use as soon as possible.



and some knowledge of naval discipline, when they would be transferred to cruising training ships, for voyages of some months at a time, until sufficiently advanced for entry into the regular service. It was recommended that apprentices should be required to serve, at least, one enlistment of three years, after attaining their majority, before being entitled to final discharge, and that a portion of the time should be spent at the training station under special instruction.

Two vessels of moderate size, one with full sail-power, both armed with modern service guns, and supplied with torpedo outfit and electric-light plant, were recommended for the training station, to be used in making short cruises with small detachments of apprentices and young recruits, the detachments being shifted from one vessel to the other for different drills and instruction. It was recommended that one of these vessels be fitted for special instruction of firemen and coal-passers in handling fires under forced draft.

The enlistment of men without previous naval service was to be discontinued, as far as possible, and minors were not to be enlisted except through the training station, unless in the case of those too old to become regular apprentices, and in such cases a longer term of enlistment than three years, as now authorized by statute, was recommended.

As the crew of a vessel of war should be composed primarily of seamen, it was recommended that the terms "Landsman," and "Ordinary Seaman," should no longer be used; that men for special duties should have rates designating, as nearly as possible, those duties, and that the seamen should be divided into three classes, according to their experience and ability, with corresponding pay. The pay of the first class seaman was fixed at a higher rate than at present, and it was provided that seamen of all classes should receive extra pay for special acquirements; in ordnance work, torpedo work, and marksmanship, at the rate of \$2 per month for each specialty. The increased pay for these specialties was to be open to all other men of the crew, with the restriction that men rated and paid for special work should not receive the additional pay for their specialties; thus a gun captain might qualify for torpedo work, or ordnance work, or both, but not for marksmanship. The present increased pay for successive reenlistments was to be continued.

It was recommended that, with certain necessary restrictions, the appointments of all petty officers should be permanent from one enlistment to another. A retiring pension was also recommended, sufficiently large, it was thought, to offer a high premium for continuous faithful service. A recommendation was made that the time between discharge and reenlistment, under honorable discharge or C. S. certificate, should be increased to six months, with pay for three months, as now allowed by law.

The guns' crews were to become the units of the organization, and the special rate of Gun Captain was recommended, with high pay, to be held by leading men in the crew who excel in marksmanship. The gun captain was to be responsible for the men under his command when at the gun or performing duty in any part of the ship; he was to replace the present Quarter Gunner

in everything relating to the care and preservation of his gun, and he was to perform the duties of a captain of a top where necessary on account of the rig of the ship.

The gun division was to take the place, for duty on deck, of the watch or quarter watch, and instead of Boatswain's Mate the rate of Division Mate was proposed, to be held by the leading man of the division, who was to command the division in the absence of an officer, when acting as a whole on drill, or in the performance of any other duty. Other rates for special duties were recommended, but enough has been said to show the character of the changes proposed. The efforts of the Board in assigning rates to men in the new organization were directed to making the title represent, as nearly as possible, the duty to be performed, to reducing the number of titles to as small a number as convenient, and to grading the pay of men for special duties according to their ability and the importance of the duty. The number of rates proposed was, in consequence, smaller than under the present system; but a more equal and regular promotion and increase of pay from grade to grade would, it was believed, be the result.

The rates of pay proposed were intended to emphasize the importance of the military and skilled elements on board ship as being greater than that of the police and clerical force employed.

I think the writer overstates the argument for dispensing with marine guards on board our vessels. Certainly the recommendation of the Organization Board was not due to any feeling that the presence of marines on board vessels of war tended to degrade the seamen, or to render them less efficient in the performance of military duties. It was proposed to withdraw the marines from ships in commission and to increase the strength of the corps considerably, with the idea that larger bodies of men being stationed together at the different navy yards, a higher degree of efficiency would result, and the Navy Department would have always at hand a compact, thoroughly drilled, and organized force to be used where landing parties were needed. At the same time it was supposed that the better class of men whom it is desired to



to carry on duty; but close supervision should never be relaxed for a moment by the officer of the watch; and no study of scientific principles, if pursued at the expense of the habit of close attention to all duty, can be to the real interests of the service.

My experience is not in accord with one of the writer's statements that the younger officers are not allowed opportunities of performing responsible duties on board ship. In every ship in which I have served since graduating from the Naval Academy, with one exception, ensigns have always been assigned to duty as regular watch and division officers, and in many of them midshipmen, or naval cadets, have been assigned to such duties, if not under orders from the Navy Department, then by the commanding officers.

Lieutenant WILLIAM G. CUTLER, U. S. Navy.—While I agree with the essayist that marines are no longer needed afloat, I would rather do so upon the ground that their room is needed for the general service artilleryman, than upon the less tenable ground of the latter's degradation.

What I regard as the most important point of the paper, viz., "Permanency of Rating," the essayist subordinates to the necessity of getting rid of the marines.

When we recognize that the sailor of the future is an artilleryman afloat, and when we rate and pay him in accordance with his value as a fighting factor, we will have made a great step in advance.

The question, "How can a better class of men be induced to man our rapidly building ships?" is of the utmost importance to all patriotic Americans. I respectfully suggest the following inducements:

1st. High pay to the skilled artilleryman.

Assuming the captain of the Boston's 8-inch gun to be what a modern gun-captain should be, there should be no man forward of her mast whose pay exceeded his. A recent article in the daily press complains that the seamen-gunners, after being instructed at Newport and Washington, are accepting positions in steel works and small-arm factories. Can they be blamed for improving upon the \$26 of the navy?

2d. Permanency of rating to the extent that no man who, after due trial, has proved himself worthy, shall lose his rating except by sentence of a G. C. M.

3d. Increase the gun-captain's authority, gradually giving him entire charge of detail drills.

4th. Improve the men's quarters and comforts to the utmost extent consistent with the efficiency of the vessel. Procure skilled berth-deck cooks. Berth servants apart from crew, and uniform them distinctively.

5th. Reduce the number of non-combatants to a minimum; servants by consolidation of officers' messes; reduction in number of yeomen, writers, etc.

6th. Exercise far greater care in the enlistment of men, especially of men who enlist in ratings.

As to the relations of officers and men, they could not but be in the following:

In port relieve the watch and division officer from much of his

watch duty; not that he may go on shore, but that he may identify himself more closely with his battery and with his men. He and his men will surely be more efficient by knowing and respecting each other. Hold the division officer, and not the gunner, responsible for his battery and all things pertaining thereto.

Require all officers to be on board during working hours. The spectacle of a procession of officers fleeing the ship at 1 P. M. is surely a cause of discontent among the men. For the sake of the men, as well as the officers, naval cadets and ensigns should not be made to do petty officers' work.

Lieutenant PAUL ST. C. MURPHY, U. S. M. C.—I have read with more or less interest Mr. Fullam's argument in support of what he considers necessary to "promote efficiency" in the navy, and while agreeing with him in certain minor matters, think that in the main his zeal misleads him, so far as existing conditions are concerned; that he errs in regard to the malign influence of "marines afloat," and that his view of the U. S. sailor of to-day is too pessimistic.

Marines and sailors have been associated from the beginning of our navy and have shared in common its toils and its glory. Marines have always contributed their full share to victories afloat, and the depressing effect of their surveillance was not discovered in the days when battles were fought and victories won. During my sea service, extending over a period of more than eleven years, I have failed to see in the blue-jackets any evidence of repressed manliness due, in even a remote degree, to the presence of the marines. The espionage complained of is exercised by the marines over their own men quite as much as over the sailors; the same is exercised by guards and sentinels in the army, yet I doubt if the *esprit* of marines or soldiers is impaired thereby. My experience warrants me in believing that the *morale* of the sailor has never suffered from contact with the marine. If sailors are to be made military, the example of a body of subordinate, well-drilled men should be a help rather than a hindrance to the development of a military spirit. Mr. Fullam omits to state that the marines, besides "watching the scuttle-butt," "attending the commanding officer," and "standing by for ceremonies," also stand reg-



see the pay in my own corps increased, especially for non-commissioned officers; but it seems to me that pay has little to do with the matter in question. Of course, pay might be so increased that there would be as much eagerness in seeking billets before the mast as is at present the case in the scramble for place in the civil service of the Government. It is something more than doubtful, however, whether, when the pinch comes, the material so obtained would be superior to the old.

And now a word for the sailor of to-day. I believe Mr. Fullam very much underrates him. The "heterogeneous crowd" to which he alludes as making up the companies of our ships of war is about the same "crowd" that did gallant service for us in 1812, and later, and that has made our flag respected everywhere. The men who followed Farragut, and the men of the Trenton who, with death staring them in the face, cheered the escaping Calliope during the memorable disaster at Samoa, were of the same "heterogeneous crowd." Whatever credit marines have gained (they have gained much and deserve more), has been hand in hand and side by side with these "foreign" tars. The same "heterogeneous crowd" fills and has always filled our army, and has proved itself, afloat and ashore, the material of which good sailors and good soldiers are made.

I fear there will always be an absence of Mr. Fullam's "American" element; that element may be heard from in time of war, but at any other time it cannot be counted on. Perhaps the present element can be made more military; it is possible, and to a certain extent desirable; but there is always the danger of taking the temper out of the steel by the grind of over "sojering." I have failed during my experience to see in the discipline and training of the navy the "unbending" and "un-American requirements" that Mr. Fullam sees; and the element that he considers driven back by them to civil life is, in my opinion, an element pre-eminently fitted for civil life; it is certainly quite unfit for the navy.

I see nothing to blush for in the past and present of the navy, and nothing to despair of in its future.

Captain LOUIS C. FAGAN, U. S. M. C.—The paper written by Lieutenant Fullam, U. S. Navy, is a powerful one, granting his theory that marines are responsible for all evil is correct; but reflection will perhaps show that even if marines were withdrawn from on shipboard, there would not be that rush of young Americans to make up the crews of ships the sanguine theorist supposes. The fact must be ever borne in mind that *life at sea is an unnatural one*, and men cannot be persuaded to exist for any length of time away from the comforts of the shore, no matter how rude these comforts may be.

American lads, as shown by the costly failure of the training system (Mr. Fullam says 90 per cent are lost to the navy), will not stay long in the service; and even if the marines were relegated to the scrap-heaps in our quiet navy-yards, the "boys" could not be induced to remain and be tossed around, even if granted a chance to look through portholes to view the world. The best proof of the bad effects that a "life on the ocean wave" produces is seen in

the discontented moods and wild fancies that enter the minds of intelligent men, when exposed to the trials of mid-watches and a sea diet, and the most polite and elegant officer on shore often becomes a perfect demon to those under him at sea; even rich men owning yachts do not stay on them any longer than is necessary to entertain and display their wealth, notwithstanding the fittings of luxury. No; the object of naval reorganization of the personnel is to supply to a ship of war men who can *do the fighting* in case of hostilities, and uphold the honor of the flag during *peace or war*. Jealousy, or prejudice, or fine-spun theories ought not to interfere with this great object. The days when promotion followed, during a three years' cruise, from midshipman to lieutenant-commander have passed never to return, *unless* we have a successful war; and to make this possible we must foster any system that gives us *warriors*, whether they wear the blue shirt of the sailor or the trim uniform of the "ever faithful." The "bone and sinew of the land" will enter as soldiers under the splendid discipline of the Marine Corps, fostered by naval commanders, when they hesitate to ship as sailors, and it would be a foolish move to displace men who are acknowledged by their bitterest foes to be efficient and faithful, in order that a few officers should be benefited by increased rank and easy billets.

We have in the Marine Corps an organization largely American, and which has been pronounced a strong arm of defense, not only by the veterans who have made the navy all it is to-day, but by the most progressive commanding officers and those highest in broad intelligence, who feel most keenly the necessity for our men-of-war being manned by the best material, regardless of personal wishes of the inexperienced.

One word in conclusion. In every community there must be a visible force to back the law. Take all the bad men out of a town, or of legislative halls, and "police" would still be necessary. How much more important is it, then, that in the unnatural life on board a man-of-war, with many of the passions suppressed among the men (picked out for their animal perfection), the captain should have a force ready to uphold the majesty of the law, and at the same time be able to undertake the management of the most complicated guns



because the navy, like other navies, could somehow get along without such an institution; and then, perhaps, the men who seek their own advancement through the ruin of others might be spared with great advantage.

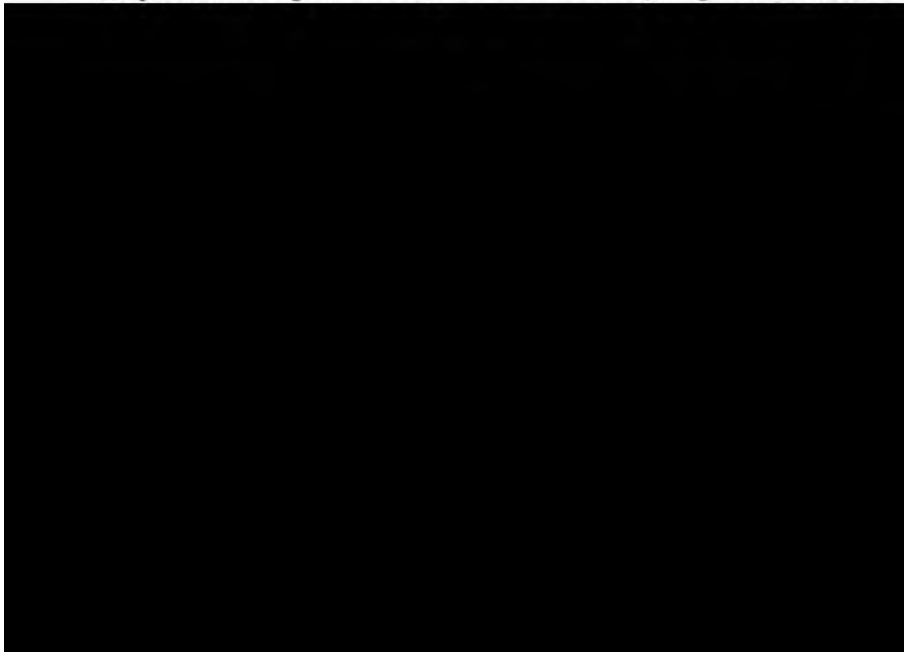
Lieutenant E. B. BARRY, U. S. Navy.—It seems to me the main idea underlying Lieutenant Fullam's essay is a condemnation, not only of the methods employed in our naval service afloat, but, also, of those employing them. I doubt if the service at large will agree with his course of reasoning. Lieutenant Fullam must have been particularly unfortunate in the composition of the divisions he has commanded on board ship; still, I think much of what he complains about is due to his own idea of what constitute *military matters*. What does he mean by this? Does he mean a rigid observance of position and motion throughout all drills, as taught in the German navy, where army discipline holds good? Would he organize our navy on the German army plan? Are these ideas "proper concessions to national traits and institutions"? Men usually follow the lead of their officer; if the one is interested in his drills and exercises, the other will be. The divisional officer is to continue and perfect what is begun in the training squadron and on board receiving ships. The essayist seems to forget that we are in a transition state, and that the entire reorganization of the navy cannot be effected in a few months. He blames the old sailor for not being a soldier. When the efforts of the Navy Department to introduce some sort of system into target practice bear fruit, when the gunnery and torpedo schools have turned out enough qualified men to captain all the guns afloat, and when *modern* instruction can be imparted more generally, then, if no results are produced, it will be time to condemn sweepingly. The vital question concerning petty officers is rating and disrating. When they can be disrated only by sentence of court-martial, many of the evils complained of will disappear. Even this takes time. Let us begin with the rate of Gun Captain; as the essayist says, diffuse these men through the service, and watch the result. There is an old dodge known as "working for a rate"; this consists in "being seen" by the captain and executive officer, but in shirking when they are not on deck. In spite of all opposition, many of these worthless fellows were rated by those in power, who naturally believed their own eyes. This will be done away with if reports of efficiency are made by all watch and divisional officers on board ship, from which to make up a man's record. This will aid the younger officer to "escape the professional wet blanket." I fully agree with that portion of the essay on quarters and comforts for the men; also, on pay and promotion. Give properly qualified petty officers good pay, permanent ratings and a retired pension; recognize that the old-time sailor is giving place not to the *soldier*, but to the gunner, and the problem is solved. I think the question of marines can be settled by a uniform system of punishments prescribed by the Department, and having it strictly enforced. Human nature is ever the same. Uniformity of rewards and punishments will go far to make men contented; stern but even justice is preferable to lax and variable partiality. I think the marine will in time be withdrawn from service afloat as he becomes more and more of a

non-combatant aboard ship. Either he is to become one of the gun's crew, the boat's crew, and one of the ship cleaners, or else his place will be taken by men to do these duties. But he will not go because of the bad moral effect exercised by him upon the ship's company, for, in my opinion, this effect does not exist. When that day comes, the divisional officer will find himself just as much responsible for the condition of his battery and guns' crews as he is to-day. He never will be able to throw his own responsibility upon petty officers.

Commander S. W. TERRY, U. S. Navy.—In my judgment, the article we have heard read this evening is not calculated to result in any good to the service. It is not only an attack upon the usefulness of the marine guard, an important adjunct of a man-of-war, but it is an unjust reflection upon the officers charged with the discipline and government of men on board ship, calculated to produce discontent among the men of the navy, and to create doubt and distrust in the people as to the efficiency of the service in general. For my part, I do not think this Institute was ever established for the purpose of disseminating any such doctrine, and for that reason I regret very much that the paper should be published in its Proceedings and distributed through the country and abroad.

At a time when the navy and our people at large are congratulating themselves that a good beginning has been made in building up the navy, the author of this paper comes forward and not only charges that our men are not treated as they should be in the matter of pay, promotion, and employment, but that such of the new vessels as the Charleston, Chicago, Baltimore, and Philadelphia are faulty in design; this is in the face of the fact that the plans of these vessels were prepared by a board of the most experienced experts to be found among officers of the navy.

While, I suppose, there is no one who will claim there is no room for improvement in the condition of the crews of our vessels, few will admit the correctness of their condition as described in the paper read this evening. The type of ships completed and being constructed, and the material composing the crews of the



circumstances it has not been practicable to afford officers as much sea duty as was customary in former times, a condition, in the opinion of the best judges, unfavorable to an efficient navy. This, in my opinion, was of greater disadvantage to officers of the junior than to those of the higher grades, as many juniors remained on shore duty from three to five years. Some of these younger officers, not long out of the Naval Academy, and with limited experience in control of men, naturally interested in the absorbing question of rebuilding the navy and providing the most improved armament for our ships, have, now and then, occupied themselves in the solution of such problems as this paper deals with, and which, in my judgment, might better be left in the hands of more experienced officers. A navy, like an army, requires time, perseverance, and opportunity, for perfecting itself as a fighting organization.

We have not had for many years a navy worthy the name, and, in consequence, our men may not be up to the standard we hope to attain. It has been impossible to train men for service in the new cruisers up to this time, but in spite of this, and before any fair opportunity is had, we hear the complaint that the men are unsuited and incapable, and that the vessels themselves are faulty in design and not of a kind to attract the American sailor, this latter being represented as exacting as to his compensation and the amount of comfort to be provided in the ship; and, further, it may be inferred that if he should choose to return from liberty, in liquor, a marine should not search him. As reference is made in the essay to the crews of the vessels composing the Squadron of Evolution, and the essayist is also on board one of them, it may be that his experience there affords ground for what he says of the unfitness of the men now enlisted for manning our new ships. I am sorry the brief cruise of the squadron should not have made a more favorable impression on his mind, and I beg to dissent from his conclusions as to the capacity of the crews of the squadron. It appears the squadron sailed in December last and returned in July following, and, judging from the essayist's paper, it might be inferred the men had not reached a very high degree of efficiency. This is not in accordance with the official reports, however.

His propositions seem to be three :

1st. To withdraw the marines from service afloat, their presence on board ship being detrimental to discipline and an implied distrust of the sailor.

2d. That in the matter of "pay, discipline, and promotion," there is not sufficient encouragement to Americans to enlist in the navy.

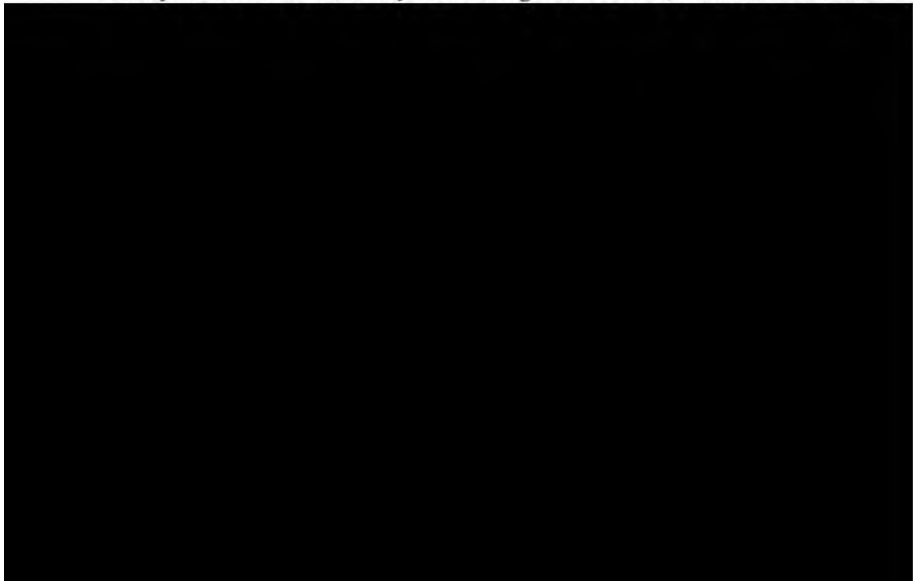
3d. That the navy is composed of a variety of nationalities, "a heterogeneous crowd"; "all languages are heard on our decks."

Now, let us suppose the marines are withdrawn. Other men, blue-jackets, would take their place, and there would be no gain in room. There will be a necessity for orderlies and sentinels as at present, and a sufficient number would be required to afford reliefs. Then there would be need for a guard on all occasions of ceremony. It is not claimed that the marines do not now perform their duties efficiently, but that sailors will do it as well. If it is proposed to employ sailors promiscuously in the duties now performed by marines, and in ship's work; the result, I maintain, will not be for the good.

We will have neither good sailors nor good marines. Men who pull in boats, coal ship, scrub decks, go aloft, etc., must, as everybody knows, become more or less unmilitary in consequence. Look at the soldier employed on police duty in a garrison or on board ship. Is he not made less a soldier by it? It therefore appears that the principal reason for desiring the withdrawal of marines from service afloat is that their presence is an implied distrust of sailors, etc. I doubt if such an idea ever existed in the mind of the sailor, for everybody knows there is no reasonable foundation for the assumption. The author should know that the duty of searching liberty-men and boats' crews, when it is done, and in well-regulated ships this should rarely be necessary, properly belongs to the master-at-arms and ship's corporals, and not to the marines; nor are marines themselves exempt from a like search. These petty officers also confine and have charge of men under punishment.

It is a strained inference to suggest that the presence of marines on board ship implies a distrust, or lack of intelligence on the part of the sailor. Such is not the case, and I deem it unworthy of notice. In 1885, when the detachment of marines were sent to the Isthmus of Panama, the guards from the training squadron that I commanded were withdrawn, and for nearly six months the three vessels were without guards. I have no hesitation in saying that the vessels were less efficient without than with the marines, and I hope never to serve in another ship without them. The Marine Corps has formed a part of the navy ever since we had a navy. They have performed excellent service both in peace and in war. Their appearance calls forth praise wherever their duties take them. Their officers are competent and work harmoniously with the navy, and I see nothing to justify the proposition to withdraw them from the service afloat.

Let us consider the proposition that there is not, in the matter of pay, promotion and discipline, sufficient to encourage Americans to enlist in the navy. Any fair-minded person who should compare the rating and pay table now, with what it was twenty-five years ago would be surprised at such a careless statement. I think I can show that our government does more than any other country in the world in the way of inducing men to enlist, and remain in the



carpenter, and sailmaker is open to worthy and capable enlisted men of the service, and these positions are very largely held by men from the service. No country provides a better ration, and few as good, as our men have. The health and comfort of our men are matters that receive constant and careful attention.

The selection of petty officers rests exclusively in the hands of the commander, and they are not deprived of their rates except the commander in his judgment deems it necessary. What better disposition can be made of this authority? I confess some surprise at the criticism of little details of duty on board ship, by officers or men. Nowhere else are so many people living in so contracted a space. The cleanliness and good appearance of a ship contribute largely to her efficiency, and, therefore, it is very necessary to look closely to minor details. Now permit me to enumerate some legislation made to encourage men to enter the navy. A man who has served not less than ten years, and is disabled, may be pensioned upon the recommendation of a board of three officers, approved by the Secretary of the Navy, (Sec. 4757, R. S.). A liberal pension is provided for any man injured in line of duty; also provision for his family in case of his death. Interest at 4 per cent upon his savings deposited with the paymaster. A home on board receiving ships, and allowance of full pay during the interval between his discharge and re-enlistment, within three months, for three years. Transportation to his place of enlistment if discharged elsewhere. One-fourth additional pay if detained in the service beyond his term of enlistment. An allowance of an outfit of clothing and bedding to an apprentice on his first enlistment. Upon certain conditions a man may enlist in a petty-officer's rating, and he cannot be deprived of this except by sentence of court-martial. And finally, any man after twenty years' service, and disabled for sea service, is entitled to admission to the Naval Home in Philadelphia, or in lieu thereof, to a pension of half the pay of his rate when last discharged, (Sec. 4756, R. S.). In the matter of punishments, Congress has carefully defined their character, and officers are held to a strict account for any deviation from the law. There are, also, many privileges and indulgences lodged in the hands of the commanding officer that are seldom, if ever, withheld from the deserving men. Libraries are provided all our ships, and the men are allowed reasonable time for recreation and enjoyment. As to the matter of the Government competing with other employers in the pecuniary compensation to those entering its service, I hold it has gone far enough when our men are paid more than two and three times what other governments pay. No country ever pretended to compensate its men in money for service in its defense. This should not be expected. A man should be ready and willing to serve in the army and navy for a reasonable compensation, and a fair provision for himself or his family in case of injury or death. This much, I claim, this country gives to those in the army and navy; and the security of these benefits is more than equal to the uncertainty offered by the individual employer.

Some officers are inclined to the opinion that there is too great inequality of pay; that if such rates as ship's writers, buglers, yeoman, and other non-

combatants are properly paid, the gun captain, boatswain's mate, etc., are underpaid. There may be something in this, but it should be remembered that the price of labor depends upon the demand. There is no market for the seamen, who are called upon for these latter positions, except at sea, while there is a demand for writer, buglers, etc., not only on board ship but on shore. Every one knows how very difficult it is to get a reliable and competent ship's writer, or yeoman. There is a certain qualification required of them which the seaman need not have, hence I think there is good reason for the difference in compensation in these rates.

Now as to the variety of nationality found among the crews of our vessels. This is greatly exaggerated. Native-born Americans are not by nature inclined to a seafaring life, if we except those on our coasts. In so large a territory as we have had undergoing settlement and development, it would be surprising indeed if the men should prefer the unsettled life of a sailor to the regular employment of a farm, of railroading, manufacturing, etc. Nor would any rate of pay that this very prosperous country could afford overcome the natural antipathy of its people to a seafaring life.

The remedy for the ills of the service lies not in the clamor for more pay and more promotions for the men, nor in the agitation of imaginary grievances by naval writers, but in a conscientious and hearty effort on the part of all officers to be content with what we have and strive to raise the service to a higher state of efficiency. It is to be observed that these complaints come from officers and not from the men, that a discontented service will never be an efficient service, and that those who disseminate the seeds of discontent are acting in antagonism to the best interests of the navy and their country.

We have many foreign-born men in the navy, it is true. Some are citizens and some are not; but I see nothing discouraging in this fact. Do we not invite immigration from every country except China? Are not these men good citizens, as a rule? Are they not elected and appointed to office under state and national government, excepting only the offices of President and Vice-President? Was it attempted to restrict enlistment in the army, or navy,

to citizens in the war of 1861-3. Are there not in the history of that war con-

generally prevented from complying with. Faithful and loyal service in the navy for a certain time constitutes, in my judgment, all that should be exacted for service in the navy; and this seems to be the view taken by the government. It is a great mistake to say that "all languages are heard on the decks of our ships," because there may be a few instances where men unfamiliar with our language are enlisted for special duties. It is not the rule, and the matter is entirely under the control of the officers themselves. The inducements the essayist considers necessary to attract Americans to enlist in the navy must strike those responsible for naval administration as extravagant beyond reason. I think I have enumerated what will be regarded by most reasonable men as quite sufficient inducements, but notwithstanding these, we are told the Chicago, Newark, Baltimore, Philadelphia, and San Francisco are not provided with sufficient comforts, such as "decks" and "more locker room," to attract Americans. This suggests a degree of fastidiousness undesirable even in the American sailor. It should be remembered that a man-of-war in these days is a combination of many important conditions, involving a harmonious compromise of all, the principal of which are speed, armament, and capacity to keep the sea. It is believed by those most competent to judge that the limit of comfort for officers and men has been reached in these vessels, without sacrificing any of the material requirements of a fighting machine, and when we compare them in the matter of comfort with those of former days there is no room for just complaint.

Now, Mr. Chairman, I confess my surprise and regret that an officer of our navy, who has not yet been charged with the more serious responsibilities of the service, should feel himself justified in drawing such a gloomy picture of the navy as the member has presented in the paper we have listened to this evening. I do not think it will have a depressing influence upon the great majority of officers; it may do the navy harm in the country and abroad. I am glad to say, if I may speak from my own experience, which began in May, 1861, and covers every grade from midshipman to the command of the Training Squadron of the three old-fashioned sailing sloops Portsmouth, Jamestown, and Saratoga, that the time never came for me to separate from the ship I served in that I did not do so with regret. There never was a ship in which my association with the sailors of our navy did not call forth my admiration and praise for their uncomplaining performance of every duty required of them. Whether our men have been called to service in the Arctic, or to the unhealthy climate of the tropics, in whatever sphere or locality duty called them, they have given a good account of themselves.

One word more, Mr. Chairman, and I have done. Every one is familiar with Jack's tendency to growl. We ourselves know that he takes this way of enjoying himself. He means no harm, and generally does not mean what he says. Take away the "shellback's" right to growl, and I fear the navy would lose some of its most valuable men! Can it be that our young friend is developing, a little prematurely, this weakness? Let us hope so. But, seriously, this paper can do the navy no good. It is simply a case of "airing our linen" before the public, to our own injury. The controversy between the

line and staff was made "a stench in the nostrils of the public," and when this seems to be subsiding, we have an attack upon the usefulness of the marines on board ship. I think this Institute will consult its right to the respect and good opinion of its readers by not publishing this paper and the discussion thereon. I therefore move, as the sense of the meeting, that its publication be suppressed.

Commander C. D. SIGSBEE, U. S. Navy.—The paper presents a more dismal view of the service than will meet with general acceptance. The fact of the case is that the navy needs reorganization, and has needed it for some time, but no man, nor set of men, has been strong enough to effect it in the face of the opposition of conflicting opinions. When the question of a new navy first began to seriously engage the attention of Congress, that body found it impossible to decide on types and policy, because of the wide divergence of opinion then expressed by naval officers on the subject. Since we are now well advanced in the construction of ships, the question of reorganization is, most naturally, pressing for decision; for to be well fought, ships must be well organized. Again, we find a divergence of professional opinion that is likely to delay the adoption of active measures. Unfortunately, the opinion of a moment is as emphatically asserted as one that flows from ample consideration.

It is doubtless the case that this paper has been made strong by its able author in order to excite discussion, and thereby mould opinion to a condition approximating unanimity. If discussion fail to convince disputants, it may nevertheless clear away doubt in high places. However that may be, we must not fall into the error of supposing that great measures can always be put into operation on the stroke of a bell. The writer's views relative to the narrow range of duties required of cadets and ensigns apply not only to those grades, but all along through the watch grades of the line, a condition largely due to the backwardness of the navy as a whole. It is to be hoped that the time is not far distant when young officers will be employed in duties commensurate with their scientific education and training. The several points raised by the



re-enlistment, for instance. This system worked well for a while and helped to fill our complements, but it will not serve to entice the new order of man. "The laborer is worthy of his hire," and the laborer knows it now if he never did before. Doubtless many a rollicking ne'er-do-well might be found to go to sea to relieve himself of the burden of orderly existence, but we should not find that kind acceptable. Our training system is good—capable of improvement, undoubtedly, but good nevertheless. The boys are well paid and well cared for, but there is only a ludicrous future offered them, and the majority of them find it out. An officer once said to me, "When a boy leaves the training service and goes on board ship for general service, he finds that he has been decoyed." If any one wish to know why naval apprentices have refused to stay with us, let him investigate the *Classification and Pay Table* of the Navy Register, and bear in mind that the apprentices are prepared for the seaman and military branch of the service. The table discloses that we have gradually drifted into a condition of rating and pay in which the military element in a military service is heavily discounted. The exhibit shows three grades of petty officers ranking the common seaman, and even the seaman-gunner. In the first grade of petty officers are found twelve ratings, only three of which belong to the seaman branch. These three are of the ship, not of the service; they offer no certainty of attainment, are not awarded on board all ships, and are commonly filled by seamen who have far exceeded the age at which British men-of-war's-men are retired from service. The pay allowed is \$35 per month. In the other classes of that grade the pay is not less than \$45 per month, and in six cases is \$60 or more. In the second grade of petty officers are thirteen ratings, of which four belong to the seaman. With one exception on each side, the same marked difference of pay, unfavorable to the seaman, is found. In two instances the pay of artificer ratings is twice that of three of the four seaman ratings. In the third grade of petty officers there are eleven ratings, of which eight belong to the seaman. With one exception the artificer ratings get more pay than the seaman ratings. The next grade has no official status and contains the seaman-gunner, the nearest approach the service has to the ideal future seaman. This grade also contains the seaman and the seaman apprentice of the first class. To oppose to them there are nine special and artificer ratings which carry more pay, with a single exception, than the seaman rating. For instance, the lamp-lighter gets one dollar per month more than the seaman, and only one dollar per month less than the seaman-gunner. Let us fancy two men of equal intelligence starting out to learn, one the duty of a seaman or a seaman-gunner, and the other that of a lamp-lighter; it is no exaggeration to say that any man fit for becoming a seaman-gunner could learn the duty of a lamp-lighter in a forenoon watch. Every rating in the table that involves the knowledge of a trade, or the possession of even minor skill, is given more rank or more pay, or both, than that of seaman. Let the investigator compare the position of captains of parts of the ship, in the third grade of petty officers, with the ratings that compose the first and second grades, and let him go back thirty years and compare the relative amounts of pay at that time; then let him compute the percentage of

increase of pay for the several ratings, so far as possible, up to the present time. He will find that the seaman has, apparently, had no very active friends. It is shown that the man most difficult to get and to retain is treated as if he were, of all men on board, the least valuable. Let us suppose that two naval apprentices of equal intelligence decide to remain in the service on completing their course in the training ships. No. 1 takes to the service at once and is made a seaman at \$24 per month. No. 2, with an eye to windward, delays three years, during which time he learns the trade of machinist. At the end of three years No. 1 has advanced far towards being our ideal seaman; he is thoroughly well drilled, and has a good knowledge of the modern instruments of warfare. If we lose him he is a loss indeed; he must be replaced by an apprentice. In addition to his experience he has the weight of more than one apprentice, because we actually have him and we do not get all of the apprentices. However, he re-enlists and gets \$1 per month additional pay as provided for by law. He now gets \$25 per month. No. 2 presents himself on board the same ship, with a dozen other machinists, to apply for a place. Being used to the ways of shipboard, and his record being known, he is taken at \$70 per month, and becomes a first-class petty officer at once. Suppose the commanding officer, overcome by sympathy, should decide to outrage tradition in favor of justice so far as to make No. 1 a chief boatswain's mate, and that No. 1 could then maintain that rating in his future service. No. 1, with the \$1 extra, now gets \$36 per month. After this second term of enlistment it will require thirty-four re-enlistments, or one hundred and two years of continuous service, to bring his pay up to that of No. 2 the machinist. If No. 2 had preferred to take a three months' course in a business college instead of learning a trade, he might have enlisted as yeoman at \$60 per month, or as ship's writer at \$45 per month, and have been a first-class petty officer in either case. In the latter and minor case it would have required nine re-enlistments, or twenty-seven years, for No. 1 to have got the same pay. There may be some peculiar working of the Classification and Pay Table that I fail to consider, but I find it impossible to understand how we can hope to retain

help to constitute the measure of class and pay. Compliment will not serve the purpose of pay. As a rule, important rank should go only with the exercise of special authority. Unless a rating require the exercise of military authority, pay should be the inducement rather than rank. The chief object of pay should be to maintain enlistment; the object of rank, to perfect fighting efficiency. Rank too widely diffused levels distinctions, and distinctions of one kind or another are the outward evidences of authority. The distinctions of rank or grade forward of the mast should be better pay, special berthing, messing and uniform, greater responsibility, accountability and privilege, restricted numbers, address by title instead of by surname alone, and permanency of rating. The more important ratings should be of the service rather than of the ship. Special pay might be given for industrial skill and for special technical knowledge, but rank should not be carried so far as to defeat the object of rank. For example, it would only weaken a regimental organization to double or treble the number of its non-commissioned officers.

I doubt that the writer expresses quite what he means when he asserts that all languages are heard on our decks. This would convey an idea of Babel. We have many foreigners, but it would be hard to find those who cannot speak English more or less well. A fair proportion of these foreign-born men are excellent, worthy men, who have learned to appreciate the flag, at least for the benefits that it confers in excess of what they have been used to. It is the American who can do better outside the service.

In respect to dispensing with the marines on board ship, it may be claimed that many thoughtful officers favor that measure, and are prepared to accept the embarrassment that may prevail for a short time in the course of readjusting the situation. If it be true, as some assert, that marines are indispensable in maintaining discipline, then it must be because the standard and habit of the soldier are better for that purpose than those of the sailor. Surely no better argument could be given for recasting the characteristics of the sailor by adopting some of those of the soldier. I will venture to predict that this is precisely what is coming, and that the presence of marines on board ship will become anomalous, and their services be relinquished.

The writer suggests a return to sail as an auxiliary method of propulsion in time of peace. While weight still attaches to the use of square sail for training purposes, many officers believing, contrary to my own views, that it is the surest means to prepare both men and officers to enter upon the new naval duties, it is a waste of verbal ammunition to urge a reaction in favor of sail for propulsion. Sail is as dead as Julius Caesar! If the present efficiency of the coal-pile warrants the abandonment of sail in any considerable degree, the development of the latent efficiency remaining in the coal-pile will banish it altogether for naval cruising purposes. Officers sometimes fall into the error of discussing this point, as if one could rationally assume, at pleasure, either 16 or 20 of the same kind of ounces to the same kind of pound; as if a ship's weight-displacement could readily be made to exceed 100 per cent. A certain percentage of the weight-displacement is absorbed by the hull; the

useful displacement remaining may be apportioned among the qualities, according to the service required of the vessel, but the total displacement, in the absence of miracle, is just 100 per cent. Sail and the adjuncts of sail have weight, and if any portion of the displacement be absorbed by sail, just so much must be taken from fighting efficiency for the supreme moment of battle.

Several weeks ago a distinguished naval officer, whose opinions have great weight in the service, published a paper in the Institute, in which he gave the strongest argument that I have heard for reconsidering the sail question. We were warned that a vessel without sail might be despatched to a distant point under steam, to give battle on her arrival, and arrive on her fighting ground unfit for fighting, through lack of fuel. It was argued that this contingency, to a country not possessed of coaling stations, demanded the retention of sail for propulsion. With much hesitation, I permit myself to differ from the conclusion at which he arrived, and for the following reasons: 1. Propulsion under sail is more or less fortuitous, and therefore unsuited to the rapid movements of modern warfare. 2. Fighting efficiency would be sacrificed to only moderate cruising efficiency. 3. It would be better to tow a coal schooner, or be accompanied by a supply steamer a certain part of the distance, as, in general, promising a more expeditious passage. 4. In modern men-of-war it is impossible to give an approximation to the old sail-power. 5. Supply schooners and steamers are our natural recourse for fueling in time of war. They are, in fact, mobile coaling stations. They may be required to rendezvous anywhere. This kind of coaling station must be discovered in order to be destroyed. 6. The *desideratum*, I submit, is not sail power, but a method of fueling in a seaway. In conclusion, it may be said that if the adoption of liquid fuel were possible, the problem of fueling at sea would be solved immediately. It would then only be necessary to tow the supply vessel astern at moderate speed, just enough to keep the tow-line taut, and pump the fuel on board the towing vessel through a slack hose.

sailors, in my long experience, have always shirked military duty, and are now, and always will be, lax in everything pertaining to military discipline. They not only try to circumvent the marines on duty, but also the officers and petty officers of the ship. On more than one occasion I have known the chief petty officers of a ship to be the leaders in mutinous conduct, and if there had been no marine guard on board there is no telling what might have become of the ship. I remember well one night aboard the *New Ironsides*. She had a crew of over 500 men. The ship anchored off Port Wagner. We had been in action that day. About 9 P. M. I was sent for by the 1st Lieut. (as the executive officer was then called). He informed me that there were a number of men drunk; the marine guard were ordered to muster on the spar-deck. I inspected them and found nearly every man perfectly sober. This great crew were nearly all more or less intoxicated, and fighting was going on everywhere. Our chief quartermaster, and nearly every petty officer was in irons that night. Every pair of irons was in use, and fully two hundred sailors were dropped down in the forward hold, and the old frigate under the enemy's guns. What would have happened had there been no marines on board?

Again, I remember well the occasion when the grand old frigate *Wabash* grounded off Frying Pan Shoal with some 700 souls on board. The marines got out a launch, manned her, carried out an anchor, etc., and Captain De Camp in his official report to the Navy Department said that the ship was saved by the efficiency and good discipline of the marine guard.

A policy of espionage, if there is such, does not tend to bring out vicious qualities, but tends to check them. All enlisted or shipped men must be examined or searched at the gangway; the same course is pursued at all navy-yards and garrisons; if it were not so, liquor would be constantly brought in, and government articles taken out. This inspection applies to marines and sailors alike, and its humiliating effect, that Mr. Fullam speaks of, I have yet to notice. The marine protects the sailor as well as government property. They are the first men called upon in case of trouble either on ship-board or on shore. Many, many times have I been called upon, in my service of nearly thirty years, to assist in quelling riots, to guard public and private property at fires, and even lives on board ship and on shore, both at home and abroad.

The type of men needed, under the conditions of modern warfare afloat, have not as yet been born; the man-of-war's-man of to-day is not competent to do both naval and military duty any more than the soldier is to do both military and naval duties, or even all military duties on shore; this is why the army is divided up into different corps to perform their varied duties. Does the presence of the marine on board ship degrade the whole service? There are usually soldiers of different corps in camps and garrisons—engineers, ordnance, etc., as well as infantry and cavalry. Because the infantry and cavalry do the police and guard duty of the camp or garrison, do they look down on the others; or do the others consider themselves a lower class? In this construction the engineer's force on board ship must be considered; they now receive the largest pay, yet some of them require the most looking after;

they form now a very large part of the crew; does Lieutenant Fullam wish to put sailors over them? In this case, were his argument true, they would be degraded by having another class of blue-jackets over them.

In time of war seamen must be taken from the merchant marine, and we all know that they are the flotsam and jetsam of the sea. The landsman will naturally go into the army. There are few native American sailors to-day. In time of peace it will, no doubt, be well to require the sailor to be naturalized. Our navy in war-time will be recruited by volunteers, and not by drafts, like some of the foreign navies which do not usually have their marines afloat. These sailor volunteers are a roving class, little bound by ordinary ties, and full of spirit (a little more than simple American love for liberty), and therefore they will require a different system of discipline. Until we again become a maritime nation, and even then probably, this will be true.

Congress will not allow men enough to fully man our ships in time of peace; therefore, if we are to have marines on board in time of war, there is need of them in time of peace to man all the guns, as well as to give them the necessary instruction on board that they may be prepared for war.

There are some points (as the upholding of petty officers in orders) in the paper which, if carried out, would increase the discipline and efficiency of the crew; but that the presence of the marine on board is the cause of whatever lack of these there is, I must earnestly protest against; to them rather is due most of the good that at present is obtained.

It is well known that the number of different things that the men, as well as the officers, should have some knowledge of are many more now than formerly, and it is also certain that they cannot have a thorough knowledge of all. The advisability is argued of giving officers different specialties, and the argument applies with as much, if not more, force to the men. Why, then, is it not better to keep the different branches to their own appropriate duties?—the engineers to the steam department, where they will be required in action, with enough knowledge of drills and firing for cases of emergency; the marines to the preparation for action and guard duty; and the sailor to preparation for



"marine" as indispensable. Others again don't want "soldiers," but are working hard for "gunners."

It is certainly a waste of energy to continue controversies based only upon some narrow signification of a word. Speaking broadly, a soldier is a man with a gun; so also is a marine or a gunner. If we look squarely at the subject, I think we can all advance a long way together without disagreement. A modern ship is an instrument designed to fight under steam without canvas, carrying small guns, great guns, and a variety of medium-sized guns and other more or less powerful weapons, with men to handle them. The ultimate object is to so organize and train these men that the highest efficiency in action may be secured. It matters not (for the discussion) what the men may be called. "Fighters" is good enough. But it does matter how they are organized and trained. Up to this point I am sure we can all go together; and, considering the certainty that the new weapons and ships will impose at least some modifications of drill, if not of organization, and the further fact that no system (however good it may be, or may have been) is good enough if we can get a better; considering this, I say, we can well afford to welcome for discussion any proposed plan for improvement, however much we may differ from the conclusions of its author.

For myself, I think the weakest point in the efficiency and discipline of our ships is with the petty officers. The conditions of their service should be made such that their interests are with the officers rather than with the men under them. They should constitute the strongest links in the chain of discipline. As to the best method of securing good petty officers I do not concur fully with the writer of the essay, who appears to think the removal of the marine guard from the ships is a first essential; while I believe further efforts should be made to obtain them without interfering with the guard.

There is food for thought, however, in his argument. A disorderly ship is among the worst of evils. No one knows this better nor feels it more than the intelligent men of the crew. The question then arises, would they be more reliable and efficient if charged with the full duty of upholding the common welfare, than if bearing little or no responsibility for it? Again, let us suppose that in a military organization on shore, some one company of non-commissioned officers and privates should be selected to do all the post and guard duty, while the others were employed in other ways, and never took their turn at the peculiarly disciplinary duties. How would such a measure affect the efficiency of the body as a whole; and, particularly, how would it affect the non-commissioned officers? Would the result be affected in any way if the special company wore a different uniform? Our military brethren can best answer these questions. A man-of-war at sea is not the same thing as a military camp on shore, and therefore the answers would not necessarily decide us as to the advisability of removing the marine guard; but they might help us to a decision.

Lieutenant-Commander HARRY KNOX, U. S. Navy.—Lieut. Fullam's paper seems to me most excellent and opportune; some may deem it radical, but none can deny that it is earnest and thoughtful.

Our types of ship and armament are undergoing radical change, and it is not unnatural to anticipate the need of change in other directions, even admitting that in the past our methods have been most wise.

I believe with the writer that it would be good policy to require the general service men of the navy to perform all military duties on board ship, and I do not think there would be any trouble in carrying that plan out at once, if law and regulation permitted it.

Our aim should be to bring the general service man up to the plane of modern requirement, and it is the educating effect of the military training that I would ask in his behalf.

The question of the selection of the leading petty officers of the ship by the criterion of marksmanship alone has always presented grave difficulties. My idea is that a leading man under one system of selection would probably be a leading man under almost any system; but he might not be a good shot, at least, not the very best. The best marksman is apt to have an inborn talent, and he may be a person of no force of character, not a leader of men, not the man that one would want for a boatswain's mate or a sergeant. This fact has led me to think that we might have a gun captain who would manage the gun and crew, but who would not necessarily point and fire; though it would, of course, be most desirable to combine the two duties in the one person.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A STUDY OF THE MOVEMENTS OF THE ATMOSPHERE.

BY LIEUT. E. FOURNIER, OF THE FRENCH NAVY.

(Translated by Prof. J. LEROUX, U. S. Naval Academy.)

The author of the present study prefaces his essay with a few general considerations upon the advances made in meteorology, especially in the study of the mechanics of the atmosphere, which is now coming to the front. Sailors will be the first to benefit by this movement of opinion; meteorology has invariably awakened in them a powerful interest, and this is only natural. "When one spends half of a lifetime upon the deck of a ship continually moving about, one meets the same phenomenon under so many different aspects that he cannot help asking himself what the determinative principle is." (Admiral Mottez.) The writer further states that his efforts have been directed to establishing upon a firm basis the conclusions that terminate his work and form its quintessence, so to speak.

NATURE OF THE AIR—THE ATMOSPHERE.

The terrestrial globe is surrounded by an envelope of air nearly inalterable in its composition at all points and altitudes: 79.20 per cent of azote and 20.80 of oxygen in volume. To those two gases, which are the principal constituent elements of our atmosphere, must be added aerial dust, carbonic acid, and vapor of water, which enter into the mixture in proportions varying according to place, season, and even the hour of the day.

The density of the air also varies with the spot under consideration, the temperature, the fraction of saturation, and, above all, the altitude. As we rise in the atmosphere, this density decreases in a rapid proportion that would assign to the aerial envelope a very near boundary, if close observations did not invalidate its accuracy beyond a certain limit. The measurements made by Bravais upon the aurora borealis permit us to reckon at 200,000 meters the height of the atmospheric column; some writers calculate it as high as 300,000 m.

Pressures.—This immense air-column produces upon every part of the earth a pressure whose mean annual value varies with the point under consideration.

The following table, arranged by Maury and reproduced in the nautical meteorology of Ploix and Caspari, gives the mean barometric height at sea in function of the latitude. We have selected in preference the southern hemisphere, owing to its vast preponderance of sea surface.

Latitudes.	Barometer.	No. of Observations.
From 0° to 5°	760.46	3692
" 5° " 10°	761.48	3924
" 10° " 15°	762.70	4156
" 15° " 20°	763.51	4248
" 20° " 25°	764.59	4536
" 25° " 30°	764.40	4780
" 30° " 36°	763.30	6970
" 40° " 43°	761.69	1703
" 43° " 45°	756.40	1130
" 45° " 48°	752.59	1174
" 48° " 50°	752.33	672
" 50° " 53°	748.78	665
" 53° " 55°	745.73	475
" 56° " 60°	743.95	1126

The annexed curve is a graphic representation of Maury's table; it shows us the existence of a barometric maximum at the tropic and the steep gradients of pressure towards the 42d parallel.

Further on we shall examine this curve in detail, but we can already



What forces are held in equilibrium by a column of mercury of Torricelli? Are they simply the weight of the air and the tension of the vapor of water it contains, or rather the sum of molecular and electric attractions of the atmosphere?

It does not seem admissible, given the great thickness attributed to the aerial envelope, that beyond the limits of this same envelope the super-elevated layers are connected with the earth by means of their mere weight. At that height, the extremely rarefied and imponderable air has not ceased to be a gas and to possess all the properties of gas; it must therefore be endowed with an indefinite expansive energy. Thus we cannot conceive of the sudden boundary between a gaseous state, of whatever kind, and an absolute vacuum, except through the adjunction of a force independent of the density of the gas under consideration. This force, which acts as a barrier to our atmosphere and prevents it from disappearing little by little into the interplanetary spaces, is found in the electrical tension of the air, which by actual experiment has been proven to increase progressively in inverse ratio of its density. In that case, electrical attraction constitutes an element in the total barometric pressure, whose principal factors are the molecular weight of the air and the tension of the vapor of water it contains.

Should a distinction be made between the total pressure of air in apparent state of repose and the same pressure when the atmosphere is in motion? We do not think so. Air pressure, with the exception of well characterized cyclonic disturbances, hardly varies a few millimeters above or below the static pressure, according to whether the winds predominating on the surface are cold and dry, or warm and moist. We cannot see, on the other hand, why air moving in a horizontal direction should prevent the atmosphere from exercising all its weight upon the earth's surface, or be capable of developing internal dynamic action sufficient to interfere with gravitation. Many cases are cited where in strong northwest gales in the Mediterranean the barometer stood above the mean. The force of the wind seems, therefore, to have little influence upon the barometric height. It is not so, however, when the wind acts in a direction deviating from the horizontal; it is evident, *à priori*, that every downward vertical component causes a rise in the barometer, and every upward ascending motion of the air decreases the pressure.

RELATIONS OF BAROMETRIC PRESSURE TO ATMOSPHERIC MOTION.

1st Principle.—It is generally admitted that the differences of pressures are the primary causes of the movements of the air. Researches into those differences, combined with the examination of the rotation of the earth, constitute the study of atmospheric disturbances: as water is set in motion by the differences of levels, and no electric current can exist without potential differences, in the same way, also, air is not displaced nor can there be any atmospheric current except by virtue of a difference of pressure.

Sometimes the above principle is thus interpreted: Every wind has its motive in front of it. That interpretation is not a correct one, for very frequently winds move athwart their determinative causes. It would be more correct to say: To every atmospheric displacement corresponds a difference of pressure that has caused the movement. We shall see in the course of this study what share the active forces that the globe in motion distributes unequally over the different parts of its gaseous envelope, contribute to the aerial circulation.

2d Principle.—The second principle upon which we shall rely is the following: When a depression takes place at a given point, the air is attracted on every side with an energy proportionate to its expansive force; that is, to its density, at least in the generality of cases. From this proposition, which to us appears evident, we can evolve a very important law: Density is greater at the surface; it is therefore by changes of air surface, in the same manner as liquid in two vases communicating at the bottom is leveled, that the equilib-

given point is apt to determine a partial depression, hence a disturbance.

2. That an inrush from the upper strata into our immediate atmosphere (whether the inrush be direct or caused by the clouds that those elevated strata contained) must produce well characterized electrical phenomena, besides considerably lowering the temperature and thus causing snow and hail.

In reality the rôle of electricity in the atmosphere and its influence upon the displacements of the air are almost unknown.

It appears probable, *à priori*, that two neighboring clouds charged at different potentials are attracted one towards the other in order to equalize their difference, and that this attraction must bring on a displacement in the surrounding atmosphere. But can this effect be felt at great distances, knowing that electric attraction varies in inverse ratio to the square of the distance? We do not think so. The primary condition for a force to make a perceptible impression upon atmospheric inertia is the duration of this same force. Now, clouds cannot long keep electricity at a high potential; if the discharge is not immediate, the expansion goes on incessantly by means of the moist air, which is relatively a good conductor.

The source of electrical production is at the earth's surface, and the reservoir, in the upper regions. Everybody is familiar with the experiment with the Armstrong boiler. The boiler remains charged with negative electricity, while the wet steam that escapes from it is charged at a positive potential.

When water is evaporated on the surface of the globe by the sun's rays, the earth acts as the boiler, and the vapor of water, rising in the atmosphere and condensing, imparts by degrees to the surrounding air the electricity with which it is charged.

To this primary cause of the production of atmospheric electricity must be added another hypothetical one, the friction of the air against the earth's surface; a part of the work thus expended could be found in the upper regions under the form of electrical potential. It is certain that the upper strata of the atmosphere cannot go on receiving the electricity rising from the earth without expansion either by a sudden, tumultuous disruption, or slowly and by degrees; in other words, this accumulated force must find its use. Storms are one of the means of bringing on its return to zero. Is electricity the determinative principle, or else does it simply make use of the cirrus that rise to the upper regions to come down again in contact with the earth?

That is a hard problem to solve, considering the actual state of meteorologic knowledge.

Whatever it may be, and until proof of the contrary is brought forth, we shall continue to think that electrical attractions are the consequences, and not the causes of the motions of the air.

VAPOR OF WATER IN THE ATMOSPHERE.

Vapor of water plays a considerable part in the equilibrium of pressures. In order to justify its importance, it will suffice to mention the formula which expresses the weight P of a volume of air V , at the temperature t , when the exterior pressure is H and the tension of the vapor of water, f .

$$P = V^{\text{liter}} \times 1.293 \text{ g} \times \frac{1}{1 + \alpha t} \left(\frac{H - 0.378f}{760} \right).$$

The formula may be translated as follows :

With even pressures and temperatures, a liter of dry air is heavier than a liter of humid air.

If, therefore, the barometric pressure be the same in two neighboring countries, the one dry and the other humid, everything being otherwise equal, it is safe to say that the air column is less in the first than in the second. Inversely, if the heights be the same, it is because the level of the mercury is higher in the dry region. The tension of the vapor of water forms an integral part of the atmospheric pressure; being absolutely independent of the particular pressure of the air, it varies in a general manner with the temperature, and for a given center, with the surface of evaporation, the

without perceptibly heating it; obscure rays reflected by the earth raise the temperature of the strata that envelop them. This air, made lighter by surface evaporation and its own dilation, has a tendency to rise to the upper regions. When the phenomena remain the same upon vast spaces, the surfaces of equal expansive force remain parallel with the earth; but the least disturbance, the least difference in the temperature of two neighboring spots may upset the equilibrium and determine a center of activity at the point where the upward pressure is greatest. The fact that heated air ascends is questioned by none; in order to demonstrate it, it is only necessary to place the hand above a lighted candle and to compare the sensation felt with the heat received when placed at the same distance from the light but in a lateral position. This difference results principally from the shock to the skin, of air molecules and carbonic acid endued with great upward velocity. And yet the products of combustion, in even temperatures, are heavier than air.

By the mere fact of its ascension the air becomes cooled; it is then that the vapor of water interferes to give by condensation renewed energy to the flagging movement. This vapor, first condensed in the form of aqueous vesicles or bladders, constitutes the clouds with their ever-varying forms; higher up, those clouds are composed of fine icy needles; it is the region of the cirrus; finally there exists, well within the confines of the atmosphere but at heights yet undetermined, a limit zone of the vapor of water, at the point where the temperature is such that the elastic energy of this vapor is null, and a limit zone of the clouds at the point where the density of the air is insufficient to maintain in suspension these meteors. If the clouds ascend still higher, this is due to the momentum of their ascending motion; and when this momentum is exhausted, they immediately descend towards the earth until they find a proper surrounding density.

Doubtless, at these limit zones stops the fluctuation of the vertical motions of the atmosphere.

INFLUENCE OF THE VAPOR OF WATER UPON THE CHANGES OF TEMPERATURE.

The water disseminated throughout the atmosphere under the forms of clouds or vapor acts like a heat moderator; it lessens considerably the variations of temperature, which would be excessive without its intervening agency. During the day the vapor of water

absorbs in its formation a notable portion of the solar heat; at night the clouds hinder the dark radiations from the earth towards the planetary spaces and thus prevent the cooling off; when the sky is clear, the vapor of water yields to the surrounding air, by condensing into dew the heat that it held. But this precious characteristic is not without its drawbacks at the point of view of variations in pressure.

This condensed vapor, in fact, maintains in space a pressure which becomes lessened, and the level of the mercury is lowered by a quantity equal to the decrease in the tension of the vapor of water. Equilibrium can be re-established only by surface atmospheric displacements whose energy is in direct proportion to the depression.

In reality the barometric fall is inappreciable as long as the changes in the physical state of the water take place slowly, by a sort of relaxing process, so to speak, as in the diurnal phenomena we have already pointed out. It is different, however, when these changes are caused by a sudden cooling off similar to that produced by the inflow of the cirrus in our immediate atmosphere. In the latter case the fall is very marked, and the consequences are a surface atmospheric disturbance more or less energetic according to the copiousness of the condensations.

The above exposé may explain the segmentation of cyclonic disturbances into the secondary whirlwinds that form in the proximity of the main depression and move parallel with its track. We shall recur to this subject farther on.

INFLUENCE OF CONTINENTS UPON THE MOVEMENTS OF THE AIR.

When one seeks to infer a general law from pure theory combined with observations of facts, he should as much as possible lay aside all the causes of exceptions. Those causes are numerous in the study that engages our attention; they are the continents.

The ideal globe in which the wind system would possess perfect regularity should be a sphere destitute of land, and whose equatorial plane would constantly blend with the ecliptic plane; the whole would be symmetrical with the equator and any meridian whatever. Those conditions are far from existing, and the problem is much more complex.

Upon continents, causes variable in the extreme, arising from the nature of the soil, its form, its elevation, its emissive power, the vegetation with which it is covered, etc., have a constant tendency to modify the state of the temperature, and as a consequence the system of pressures.

The resistance that continents present to the motions of the air must necessarily exert an influence upon the velocity as well as the direction of the winds; and if, in order to deduce a general law, we were to consider only the limited spaces occupied by these lands, the results obtained would be justly considered doubtful.

When sailing over the oceans, especially the largest ones, one is struck with the harmony that reigns in that apparent chaos, and feels naturally inclined to seek the primary causes.

This is the task we shall undertake, now that we know how to assign the atmospheric disturbances to the differences of pressures, and have specialized the forces that act upon the level of the barometer.

RÉSUMÉ OF THE ATMOSPHERIC MOTIONS OBSERVED ON THE SURFACE OF THE GLOBE.

The wind system is nearly symmetrical in regard to the thermal equator, which oscillates a few degrees with the declination of the sun, north of the geographical equator.

In the regions between the tropics and the equator blow nearly constant winds, which have received the name of "trades," and which blow from the northeast in the northern hemisphere, and from the southeast in the southern hemisphere. The trades of the two hemispheres are separated by a calm belt; their polar limits oscillate with the declination of the sun.

The zone occupied by the trades is sometimes crossed, notably during the shifting period of the isothermal lines, by whirlwinds forming complete circuits, the winds shifting in an inverse direction of the hands of the watch in the northern hemisphere, and with the hands of the watch in the southern hemisphere.

These whirlwinds or cyclones are incited with a motion of parabolic translation whose concavity is turned to the east.

Higher up the trades, begins the belt of variable winds, in which the predominating winds blow from the southwest in the northern hemisphere; from the northwest in the southern hemisphere. (These winds have received the name of "counter-trades.") In this belt, the winds move generally (at least, in appearance to an observer standing still) in a contrary direction to the cyclonic rotation above referred to.

Finally, higher up, a limit not easily defined, but supposed to be near the 40th parallel, the winds blow nearly constant in a direction comprised between north and south, through west. This zone is called the belt of the general western winds.

We shall now try and explain all these movements and deduce a few conclusions relative to navigation in the belt of the general winds.

INFLUX WINDS (VENTS D'ASPIRATION).

When a communication is opened between two rooms of unequal temperature, an inferior current of cold air flows towards the thermal maximum, while an upper warm one flows in an inverse direction. The difference in temperature creates a difference of pressure. In order to re-establish the equilibrium, a displacement of the air is necessary—the cold air, being heavier, flowing below; the warm air, lighter, above. The whole solar action on the surface of the globe may be summed up in these few words.

The most remarkable cases of winds of “aspiration” or influx air currents are the land-and-sea-breezes, the trades, and the monsoons.

At a great many points upon the shores of the oceans there have been noticed two inverse atmospheric motions in the course of the same twenty-four hours. During the day the lands get more heated than the seas; the layers of air that envelop them become dilated, and, rising to the upper regions, create an inflow whose center is at the same time the thermal maximum and the barometric minimum; the sea breeze that rushes in to fill the vacuum begins to blow in the early hours of the afternoon. During the night, on the other hand, the land loses through radiation more heat than the sea, the barometric minimum shifts conjointly with the thermal maximum, and the flow of air seawards begins in the early hours of the morning. In either case the return of the heated air takes place through the upper regions of the atmosphere.

OBLIQUITY TO THE MERIDIAN OF THE TRADE-WINDS AND
MONSOONS.

The trades being occasioned by the difference of pressures, which themselves result from the inequality of temperatures, should always move parallel with the meridian, since this inequality is most marked on the meridian. But all the parts of the globe revolve to the east with a velocity proportional to the cosines of their latitudes; hence it results that the molecule which possesses at its point of departure a given velocity is behindhand on the successive parallels that it crosses to reach the equator; its relative motion is, therefore, oblique to the meridian. This is why the north trade blows from a quarter nearing northeast, whilst the south trade blows from near southeast.

MONSOON OF THE INDIAN OCEAN; RETROGRADE MOTION.

During the northern summer the rarefaction of air produced by the overheating of the vast plains of Central Asia transforms the northeast trade of the Gulf of Bengal into a southwest monsoon. It must be noted that the extending motion of the monsoons is a retrograde one; that is, it takes place inversely with the direction of the wind. Thus, when the southwest monsoon of the Indian Ocean sets in, it is first met with in the northern parts; it progresses backwards; it is observed at Calcutta earlier than in Ceylon, and in Ceylon earlier than on the equator; every day it is 15 or 16 miles farther to the south.

This motion, so characteristic, defines quite accurately the breezes of "aspiration," and justifies the name. Let us also observe that the monsoon of the Indian Ocean partially destroys the symmetry of the wind system relatively to the equator. In the Mozambique Channel the winds in October predominate from south-southwest, south, and southwest, and continue to blow from those quarters down to the equator. They thus join off the coasts of Africa the southwest monsoon, which reigns north of the equator in the sea of Oman and Gulf of Bengal. This is not an exceptional case, but is the largest body of air that establishes a communication between the two hemispheres.

IMPETUS DUE TO THE ROTATION OF THE EARTH; IMPELLED
WINDS.

When we sail up the tropics the unequal distribution of heat over the surface of the earth is insufficient to explain the atmospheric

disturbances. The temperature of a spot, in fact, is solely a function of the latitude, setting aside the continents; and if it be true that the force of the flow is less as we get farther from the equator, it is no less true that the "aspiration" works from place to place gradually, so that the air column of a given parallel is drawn towards the warm regions through the vacuum created by the moving columns of air of the intermediate parallels.

Why then do we see this motion stop on either side of the equator near the 25th parallel? It is because the mean barometric pressure keeps constantly increasing from the 25th parallel to the equator, and constantly decreasing from the 25th to the polar regions; yet the air of the higher latitudes is colder, less saturated with moisture, and weighs more to the same volume than that of the lower regions. It is then necessary that the thickness of the atmospheric stratum go on decreasing from the limits of the trades to the poles—in other words, that the pole be rarefied. The cause of this decrease is entirely in the centrifugal force occasioned by the rotation of the earth upon its axis.

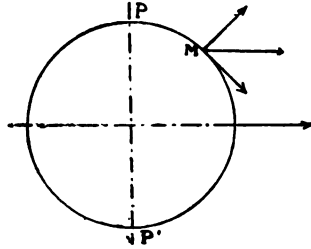


FIG. 2

through a given molecule normal to the envelope that contains it—an envelope that can be conceived as perfectly moulded on the form of the globe? This indeed would be the case, and the gaseous envelope would have no relative motion to the earth, the angular velocity remaining the same to the extremities of the aerial radius, if the sun did not determine in the mass vertical indraughts (aspirations) along this radius, and as a consequence, displacements in the direction of the meridian.

The effect of the sun being to change constantly the level of surfaces of equal expansive forces, the atmosphere cannot remain indifferent to the tangential component of rotation; but at what height does this force find the most favorable field to exercise its action?

It appears rational that close to the earth, friction, the pressure of the upper strata, and the cohesiveness of the molecules to each other, raise an impassable barrier against the tangential component; but the situation is quite different in the upper regions of the atmosphere, where the air, being lighter and freer, is endued with extreme mobility, and yields unrestrained to every impulsion. Moreover, its lineal velocity of rotation, and consequently its centrifugal force, is greater than on the surface. The air of these regions is therefore drawn towards lower latitudes, and this impulsion is marked, as shown by the barometric curve, by an increase in the density of the atmospheric envelope from the pole to the 25th parallel. The difference in pressure between these two points represents the work accomplished by the tangential component of rotation.

It is evident that air cannot keep thus accumulating towards the lower latitudes without seeking an issue. On the other hand, the rarefied regions of the pole become in turn indrawing centers, and it is for this reason that we see predominating, from the limits of the trades up to the higher latitudes, surface breezes that blow from southwest in the northern hemisphere, from northwest in the southern hemisphere. These breezes start at the north and at the south, according to the hemisphere; the rotation of the globe then modifies their initial direction, because they are in advance, upon the successive parallels that they cross in reaching the poles. To this primary cause of the prevalence of the western winds in the extratropical belt must be added the tendency to the algebraic equilibrium of the impulsion of the air.

Here a few words of explanation are necessary. If the earth were isolated from the sun, in order that the period of gyration around the

axis should be constant, it would be necessary that every aerial displacement, in whatever direction, caused by an interior force, should have for a corollary a motion equal in quantity and in an opposite direction. Now, it is admitted that the earth throws off from its bosom towards the interplanetary spaces a quantity of heat at least equal to that it receives from the sun. The forces developed by this luminary may, therefore, be considered as interior forces in the interval when the quantities given out and received are equal: we have then the right to apply to the whole of the forces that govern the atmosphere the theorem of the interior forces, and to establish as a principle that the algebraic sum of the impulsion given to the aerial envelope tends to zero, and becomes strictly null from one year to another.

The trades of the two hemispheres cover a belt representing nearly two-fifths of the whole surface of the globe. They have a very marked west component, due, as already explained, to the rectilinear velocity eastward, which attains its maximum at the equator. Having reached the center of indraught, these great gaseous masses annul their polar component and, rising in the atmosphere, continue to move westward by virtue of their acquired velocity. The movement is all the more marked, as the height they reach is greater. It is only by slow degrees that they swerve towards the poles to become decidedly southwestward and northwestward, according to the hemisphere. It will be readily seen that in this immense area up or down, the motions of the air in the majority of cases are westward.

In order that the equilibrium of the impulsions be a fact, it is necessary that in the extratropical belt the motions of the air be in a

site journey? The theory of the return of the two upper currents, on the contrary, furnishes us with a rational explanation of that maximum; thanks to this very meeting, the trade and counter-trade are naturally fed. And now let us study the origin and formation of the normal whirlwind or anticyclone.

But first, we must mention a secondary effect of the tangential component of rotation, an effect that has recently been pointed out by the eminent American meteorologist, W. Ferrel, and which may be expressed by the following formula: All aerial currents flowing eastward tend to the equator, and all currents flowing westward tend to the nearest pole.

When the atmosphere is at rest relative to the earth, the centrifugal force with which it is endued is the same as that of its contact parallel; but if its velocity eastward or westward be greater or less, its centrifugal force, and, as a consequence, the horizontal component of this force, will be superior or inferior to that of the same parallel. The aerial current will therefore assume in regard to the earth a relative motion whose direction will be governed by the difference in the centrifugal forces, towards the equator, if moving eastward, towards the pole, if moving westward. With these conditions, the law of the wind-gyrations appears to be in plain conformity with the phenomena that come under our daily notice. In the northern hemisphere the winds revolve like the hands of a watch; in the southern hemisphere in an inverse direction.

NORMAL WHIRLWIND OR ANTICYCLONE.

The barometric curve points to the existence of a maximum upon the parallels near the tropic; on the other hand, we know that this line is the starting point of the trade going towards the equator and the counter-trade going up towards the pole. The apparent anomaly of this maximum and flow of air in two opposite directions can find an explanation only in the meeting of the superior return currents: the return of the trade in the upper regions of atmosphere, and the impulsion of the polar air towards the equator, also in the upper regions.

How will the meeting of these two upper currents take place, and what gyratory movements will they originate? Both are evidently oblique to the meridian, and both possess a tendency to gyrating due to the tangential component of rotation. Considering only the southern hemisphere, we see that the direction of the polar current

is from the southeast, with a tendency to blow from a point of the compass that removes it farther from the equator, east-north-east; the direction of the equatorial current is from the northwest, with a tendency to blow from a direction nearer to the pole, west-south-west. If we suppose that the impulsions are destroyed by the meeting of these two adverse currents, there remains present only their tendency to gyrate in the same direction, and the normal whirlwind is formed. This influx of air from two opposite directions will seek an issue in a vertical direction above as well as below; hence a descending current that feeds the trade and counter-trade, and an atmospheric inflation clearly demonstrated by the barometric maximum noted on the curve.

Such are the conditions under which the two upper currents will meet: around the center the breeze revolves in an inverse direction to the hands of a watch, the polar current to the right, the equatorial current to the left.

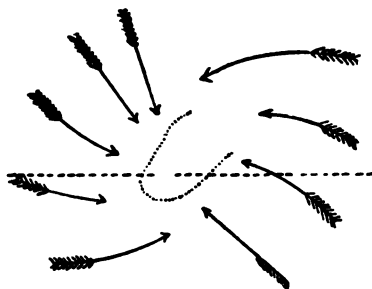


FIG. 3.

one. Around the Azores the breeze revolves like the hands of a watch; around Tristan, in a contrary direction. These two symmetrical gyrations agree perfectly with the barometric maxima described at those two points during the above-mentioned seasons.

SUMMER INFLUENCE.

These movements are principally noticeable during the summer. In this season, in fact, the difference of pressure between the higher and lower latitudes becomes less, the atmosphere expands under the beneficent influence of the solar rays, and the tangential component, whose action as we have said affects the upper regions only, carries towards the equator a light atmosphere, whose energy is feebler than in winter; everything takes place, therefore, as if the density of the atmospheric envelope had increased in the high latitudes. Moreover, the flow of the trades is diminished in consequence of a greater uniformity in the distribution of heat; the upper return trade is therefore less energetic, all the movements are more quiet, and the two upper currents, instead of rushing to fill a vacuum and create formidable whirlwinds, oppose one another from the effect of their acquired velocity, and form a calm area and a barometric maximum upon their meeting parallel.

STABILITY OF THE NORMAL WHIRLWIND.

The volume of those great masses of whirling air has no transitory motion, and there is no reason why it should. If the supply of the equatorial current is more abundant than that of the polar current, it seems that the latter, traveling a greater distance and distributed over a larger area, must be endowed with a greater velocity, and the energy of the two is thus equalized.

ROUTE OF A SHIP IN A NORMAL WHIRLWIND.

A ship running east-southeast in the South Indian Ocean, and meeting the cyclone on the west side, will notice the breeze working from north to south through the west, the barometer remaining high, but lowering somewhat with the northern winds, to rise again with the southwest winds. If the route of the ship should cause it to sail too close to the center, it will meet with calms characterized by a barometric maximum.

All these results perfectly agree with the data furnished by experience.

Conclusions.—These normal whirling motions are not fleeting meteors like the cyclones; their diameter is considerable, and the conditions they determine in a given region may endure for months. These normal whirlwinds or anticyclones cause great changes in the temperature—extreme heat in summer, intense cold in winter; this is caused, apparently, by the dryness of the air columns descending from the upper regions.

ABNORMAL WHIRLWINDS OR CYCLONES.

The cyclone is a whirling motion of the air in which the breezes revolve in the same direction in the same hemisphere. In the center of the vortex, characterized by a great barometric depression, there exists a relative calm; this central portion acts like a flue for the air streams in motion. All these whirlwinds describe a parabolic trajectory whose concavity is turned eastward.

Where do they originate, and to what agency do they owe their formation? Cyclonic movements are met with in all latitudes; they reach the coasts of France and England only after crossing the Atlantic from southwest to northeast, or from west-southwest to east-northeast; but the breezes revolving around their center are far less energetic than in the intertropical regions. Cyclones appear to originate in the neighborhood of the thermal equator, particularly at the time of the change of the monsoons in those belts where there exists a double annual system, and at the time of the displacement of the isothermal lines in the zones where the trades blow free. For instance, in the South Indian Ocean these storms occur most frequently during the months of February and March at the north

excited a lively interest among the learned, and has given rise to two contrary opinions: the theory of "aspiration" or ascending motion; the theory of descending motion, due to M. Faye. Both theories have their fervent adherents; it is not our province to solve the controversy; we shall simply sketch the main lines of the dispute and point out that neither theory is exempt from scientific criticism.

Theory of Aspiration.—The older in point of date, and also the one that rallies the most adherents, is the theory of aspiration. We defined it in a few words at the beginning of this study.

When a center of depression is created at a given point, owing to a more active evaporation, to the superheating of the air masses that envelop the earth and find their expansion in the upper regions, and owing also to the vacuum that the incipient monsoon creates behind it at the moment when the dying monsoon still keeps on its course—the air is solicited on all sides with an energy proportional to its expansive capacity, *i. e.*, in most cases to its density. As the density is maximum at the surface, the equilibrium of pressure tries to reform by renewals of surface air. But the directions of the inflowing breezes are modified by the rotation of the globe, so that these breezes, instead of directly reaching the center and filling the vacuum, can do it only after a succession of spiral movements. The centrifugal force developed by the curving of air currents contributes to perpetuate the movements by moderating the influx to the center. The gaseous masses that finally penetrate into this flue-chimney must acquire, at least at a certain altitude, a considerable ascending energy, if we are to judge from the great heavy clouds that pour down upon the whole periphery of the vortex after visiting the upper regions. During this journey the liquid drops have turned into fine icy needles. When their energy in centrifugal flight, as well as in height, is well expanded, they incline earthward by the law of gravity, and cause in the spaces surrounding the trajectory of the cyclone atmospheric disturbances, such as thunderstorms, water-spouts, and secondary depressions.

Cyclonic Translation.—Cyclones change place; they move in a parabolic curve whose concavity is turned to the east. But here rests the theory of aspiration, powerless to define the reason why in the intertropical zone the whirl appears to be drawn by the upper air masses instead of following the motion of the lower stratum.

THEORY OF THE DESCENDING MOTION.

M. Faye compares atmospheric disturbances, such as waterspouts, hurricanes, cyclones, etc. (the magnitude of effects depending solely on the energy of the forces at work), to the whirling motions forming in streams, from the inequality of velocity in the surface, liquid threads or currents. "When in a stream there occur differences of velocity between currents flowing side by side, there is a tendency to form at the expense of those inequalities a regular gyratory motion around a vertical axis. The spirals described by the molecules are perceptibly circular and central with the axis; they are, to speak more correctly, like the threads of a screw slightly conical and inclined downwards, so that by following a molecule in its movements one sees it revolve with rapidity around the axis, which it nears little by little with a descending motion much less rapid than the lineal velocity of rotation."

According to the above theory, therefore, the origin of waterspouts, tornadoes, hurricanes, cyclones, etc., would have nothing in common with the physical phenomena we notice on the surface of the globe; it would exclusively proceed from a difference in the lineal velocity of air currents moving above our heads, and *ipso facto* be a pure caprice of the elements. Everything would take place as if the confines of a mass of air in motion and the vacuum were as decided as the surface of a stream of water; as if the density of the air were uniform from the top of a whirlwind down to the bottom, the same as in the hydraulic mass.

We have seen that the origin of cyclones is intimately connected

column of air is sucked up by the whirlwind to that prodigious height where the atmosphere is, so to speak, imponderable. On the other hand, the descending column, as represented to us, is composed of air currents inferior in density to the strata through which they must pass. Here is something abnormal that the mind cannot easily conceive. Does it not require a steel point to pierce bronze or iron? And would it not be consistent to suppose that under the pressure of the gaseous masses flowing from top to bottom, the level of the mercury should rise? Now, it is just the contrary that happens.

Those are not the only objections that can be raised against M. Faye's learned theory. In order to explain away gyration, which is always the same in the same hemisphere, we are simply told: "the direction of the rotation of cyclones may be attributed to the fact that in these extremely curved currents, velocity diminishes transversely from the concave edge to the convex." Contradiction is very difficult owing to the impossibility of verifying the assertion, but the explanation is not one that will fully satisfy the mind; it is a statement *ipso facto*.

Finally, one last objection: in all the cyclonic disturbances that visit our shores (Europe), the winds felt at the surface have a decided centripetal tendency. It suffices, in order to make sure of the fact, to cast a glance upon a synoptical chart of isobares when a depression traverses Europe from west to east; the breezes converge towards the center as if a regular suction took place there. In the hypothesis of the descending currents it would seem, on the contrary, that the moving gaseous masses should expand, in diverging, from the base to the periphery.

It should be stated that lately* M. Faye has made an important concession to the theory of "aspiration": he admits, *à priori*, "two cyclones with very different depressions," the ordinary intertropical cyclone and the fixed depressions, "where the succession of phenomena works quietly; it is a question of static meteorology. There are formed towards the periphery more or less convergent breezes (regularly deviated by the rotation of the globe), but no violent gyrations. The air *ascends slowly* in them."

In the following sitting,† M. Mascart, the learned superintendent of the "Bureau Central Météorologique," whose opinion in such

* Comptes rendus of the Academy of Sciences, July 2, 1888.

† Ibid. July 9, 1888.

matters is too weighty to be passed over in silence, took notice of that declaration in the following terms: "With the exception of the meaning attributed to *fixed depressions*, and the relative importance of the phenomena, this is a new concession that I am happy in recording. I should be pleased to hope that our colleague will go a step further, and, yielding to the evidence of facts established all the world over, recognize that the partial convergency of the wind in depressions is the general rule, as well in cyclones of all kinds as in the mean annual or season effects."

We must add, before finishing this cursory glance at the theory of descending motions, that if the various criticisms we have formulated be swept aside, this theory explains quite satisfactorily the movement of translation of cyclones and their segmentation into secondary whirlwinds. This is one of the most important points where the defenders of the "aspiration" theory fail obviously; none of the explanations upon this point published up to the present, at least as far as we are aware, fully satisfies the mind.

M. Faye has, after all, stirred up a world of new ideas and fixed the minds of the learned upon a question worthy in the highest degree of their attention.

After all, what is of importance to the sailor is not the "why" but the "how" of cyclones. It is to his highest interest that he should be filled with the idea that cyclonic movements of closed circuit are met with in all parts, that he learn to recognize their approaches under the higher latitudes, and manœuvre in view of his objective point instead of resigning himself to kick about on the same spot from sheer ignorance in regard to the phenomenon.



Such being the case, the rules we are acquainted with are all that can be desired, and it will always be possible, provided the structural strength of the ship will allow it, to sheer off from the center in order to avoid the greater force of the hurricane.

We must, however, make some reservations in regard to one of those rules set down by Commander Bridet in his work on hurricanes in the Indian Ocean. It is known that the approach of the cyclone off the island of Réunion is indicated by a violent freshening of the breeze, besides the fall of the barometer and the leaden gray clouds that sweep over the sky. Admitting as a principle that the center of the disturbance is always at right angles to the wind, Commander Bridet advises captains who notice the trades increasing in freshness without changing direction, to bear away so as to cross the path of the cyclone forward of the center, and to keep on this course until the barometer shows a decided rise, and the wind begins to veer to south and southwest. At this moment, bring to on the starboard tack.

The above manœuvre would be perfect if the air currents described an exact circumference; but it has been pretty well ascertained that, at least within a certain distance, the winds converge partially towards the center of the inflow. The ship that would strictly follow the above rule would be in danger of running into the cyclone, and perhaps passing through the very center that she was trying to avoid. To provide against this grave danger it would be only necessary to bear up two or three points, *i. e.* to steer west-northwest or west instead of northwest; but every ship will not be able to steer that course, and the advice applies only to strongly built vessels; the others will simply come to on the port tacks and maintain their position if the wind veers to the east and north, and put about, on the contrary, if the wind veers to the south and west.

GENERAL WESTERN WINDS.

When we sail higher up than the 40th parallel, the atmospheric circulation on the surface hardly varies except from north to south through west, or the reverse according to the hemisphere.

In these parts (Europe), as has been admirably shown by M. Lephay, the west winds are an indication and the consequence of a depression crossing the Atlantic from southwest to northeast. Around this depression the winds revolve in an inverse direction to the hands of a watch, so that an observer standing still may see the

breeze veer from southeast to northwest through west, if he is to the right of the path; from east to northeast, and northwest if he is to the left. It happens in most cases that on the left edge of the cyclone, which is the manageable half-circle, the winds remain feeble, even blow from the west, the velocity of translation being greater than the gyratory motion. The center of the disturbance generally passing south of Ireland going towards Central Russia, it follows that the French coasts are swept by the right edge of the cyclone, on which the breezes blow from southeast to northwest passing through west.

Must we adopt for the whole of the zones of the so-called general western winds the conclusions reached by M. Lephay in regard to the Atlantic, to wit, "that the existence and vagaries of a well established aerial current are proofs of the passage of a cyclone in the neighborhood"? We do not think so. Certain well observed western gales, for instance the strong winds on the Needle Banks during the southern summer, present but a slight resemblance to cyclonic disturbances. On the other hand, what mostly strikes the navigator in the Indian Ocean or the Pacific is the persistence or rather the permanency of the western winds. Some ships have sailed over the immense extent of seas that reach from the first meridian to Tasmania without encountering an eastern breeze even for an hour. There must then exist in our part of the globe conditions that can be explained only through the influence of continents. We are too near the Gulf of Mexico, where cyclones have their origin, and the American continent is too close to allow the winds fair play in the interval that separates us.



west and southwest, as much owing to the tangential component as to the general law of algebraic equilibrium of the motion quantities. If these winds renew themselves constantly with the same gyratory motion, it is because the forces that rule them are constant, independent of the temperature, and because they derive from the rotation of the globe around its axis a movement that is uniform and constant. We even believe that the anti-trades (southwest in the northern and northwest in the southern hemisphere) would be as regular and as permanent as the trades, if their air channel did not go on narrowing, whilst that of the upper wind of impulsion, on the contrary, goes on widening; in other words, if the relation of surfaces to be attained was not zero or infinity. In the relative conditions in which they are placed, the performance of these two superposed winds can only be a succession of fitful inrushes seeking to realize an impossible dynamic equilibrium.

Let us suppose that we stand still on any spot whatever in a high latitude and observe what takes place on the surface. The winds having originated in the north to die out in the south, after passing through the west, have determined a rarefaction in our west and a relative barometric maximum in the east. In virtue of the continuity of the pendular movements, the end sought has been overreached; therefore it becomes necessary to fill up anew this rarefaction that solicits the breeze on all sides. But while from the north or northwest fresh supplies are constantly arriving, on the southeast the air keeps on rarefying, owing to the flowing towards the pole of the whole lower mass; there is therefore no equality in the struggle about to begin.

Three cases may then present themselves: either the depression will be filled by the northwest winds alone, and the movement will continue as before, or else the southeast winds will be feeble and, after passing around east and north, will die out after a short while before the flow of the northwest winds; or again, the depression may be such that the energy of the eastern breezes may not be unimportant, and the combined evolution of the two opposing winds around the center of depression will create a cyclonic movement that will sweep like the lower stratum from northwest to southeast. As may be presumed, the latter will occur only in the case of a marked depression, for instance, when the western winds have been very violent; thus one storm begets another of a different nature.

We repeat, that in our part of the world, where the solar action operates through the continents in quite a different manner, the sur-

face meteorologic phenomena must present a different character; the anti-trade rises no doubt to a certain altitude, where it reigns supreme. It is, moreover, well known that in mid-Atlantic the west winds are more prevalent than near land, and that in winter they are uninterrupted. But in the south seas, where these disturbing causes are absent, where resistance to the movements of the air is almost null, atmospheric phenomena present a great regularity; this is confirmed by reports of captains and books of navigation, and we cannot do better than to compare the alternate action of west and east winds with the pendular motion of a ship well heeled over: when the reactions on the immersed side are very energetic, the ship, passing the vertical line, rolls to windward, but only to roll all the more heavily to leeward; the roll to leeward corresponds to the west winds, and the roll to windward corresponds to the east winds.

GALES OF WIND ENCOUNTERED BY THE TRANSPORT
LA DORDOGNE.

It must not, however, be supposed, on the strength of what precedes, that sailing over the zones of the western general winds presents no difficulty and that the breezes are invariably favorable. The winds will sometimes sweep violently over them from the east. In such case one can easily judge whether he has to deal with a cyclone, and manœuvre accordingly in order to save time and distance. This we propose to demonstrate from our own experience.

In a voyage around the world, from the latter part of 1883 to the middle of 1884, the sailing transport La Dordogne encountered within a month three successive gales in the southern hemisphere. Let us analyze them.



became more favorable; finally, on the 13th, at 8 in the morning we continued our route east-southeast, with a fair breeze from the west. Later on, the wind backed to northwest, blowing a fine, steady breeze.

Fig. 4 represents the relative movements of the cyclone and the ship. Struck by the cyclone with winds from east-northeast, we sailed over a chord of the dangerous semi-circle. We assumed as the direction of the movement of translation of the whirlwind the position of the wind at the moment of the barometric minimum north-northwest to south-southeast.

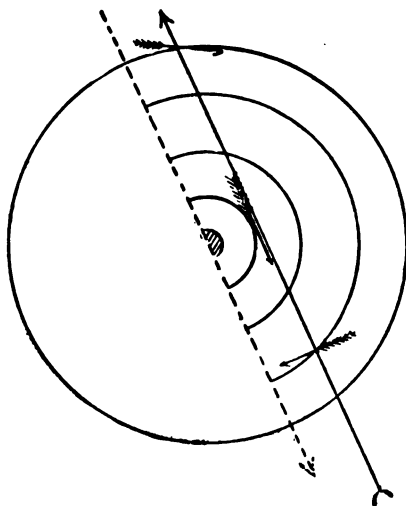


FIG. 4.

It may be seen by the figure that the convergency of the wind is almost null as well at the isobars of the front part of the whirlwind as in the second part. We may conclude from what precedes that we crossed in its dangerous semi-circle a revolving storm going south-southeast.

Gale of December 25th.—On the 24th of December the Dordogne stood at noon in $43^{\circ} 40'$ south latitude and $42^{\circ} 32'$ east longitude, with a light breeze from east-northeast, the barometer at 754. At midnight the wind blew moderate from east-southeast, squally overhead, the barometer indicating 749 and falling rapidly during the night, wind freshening. At 6 in the morning we lay to on the port tack, wind very fresh from southeast, barometer 73°

the barometer stood 734, the wind blowing a gale from southeast. From that moment the wind shifted to west and the barometer rose. At 8 in the evening the wind was from the west-southwest, blowing a strong breeze; barometer 745. Finally, at 10 in the morning of the 26th we hauled east-southeast with winds varying from southwest to west.

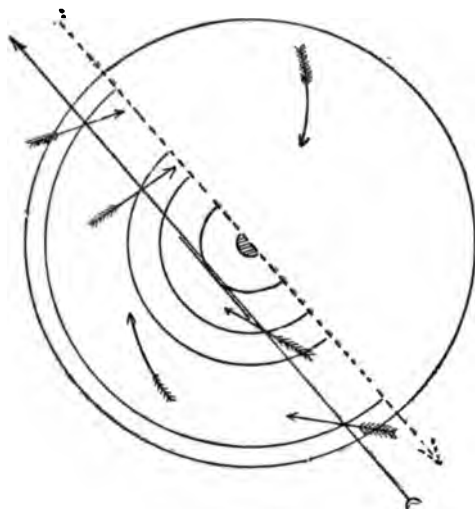


FIG. 5.

As in Fig. 4, we have chosen as direction of the path the position of the wind at the moment of the barometric minimum, but in Fig. 5 the air streams are decidedly convergent. We may again conclude

day the wind shifts about; from west-northwest it veers to southwest, and suddenly jumps to south-southeast, then northeast, and, finally, towards 7 o'clock in the evening settles at southeast, freshening gradually; the barometer has fallen 4 mm. The course is set at north under shortened sail, with orders to keep the wind four points on the quarter, hauling to starboard as the wind veers aft.

This was done. During the entire night, the ship going under close-reefed foresail and fore-staysail, keeps the wind four points on her quarter; at 2 o'clock the barometer stands 475 mm. minimum point, the breeze blowing from south; at 4 o'clock it blows from south-southeast; finally, at 11 o'clock in the morning we resumed our course east, one quarter south, with wind from the southwest; the sea was very choppy, an unmistakable proof of the passage of the cyclone. We lost 70 miles nothing, but the winds were favorable, while on the western edge the fluctuation of the barometer was insignificant. Owing to this skilful manœuvring, we saved, perhaps, 36 hours of lying to, and took advantage of favorable winds, which, in cyclonic disturbances in the southern hemisphere, are north of the adverse winds.

We will remark, in passing, that such manœuvre is practicable and unattended with danger only when the ship is assailed in the manageable semi-circle, where the breeze is far less violent than on the other side. Besides, if from the beginning the ship is kept before the wind, there is very little need to fear that the convergency of the winds will drive the vessel into the calm center, owing to the east component of the movement of translation of the whirlwind, which takes the cyclone farther away while the ship heads a course near to north.

We cannot cite many examples of a similar manœuvre, but there is as much value in one single experience as there is in a whole series, and there is no possible reason why a successful manœuvre of the Dordogne would not prove equally so with any other ship.

What is most important to remember in regard to the preceding examples is that:

1. The whirlwinds of the high latitudes may form a complete circuit, *i. e.*, have their share of east winds, which winds are adverse when sailing eastward.
2. The extra-tropical whirlwinds of the southern hemisphere follow a track lying between east and south, generally close to southeast.

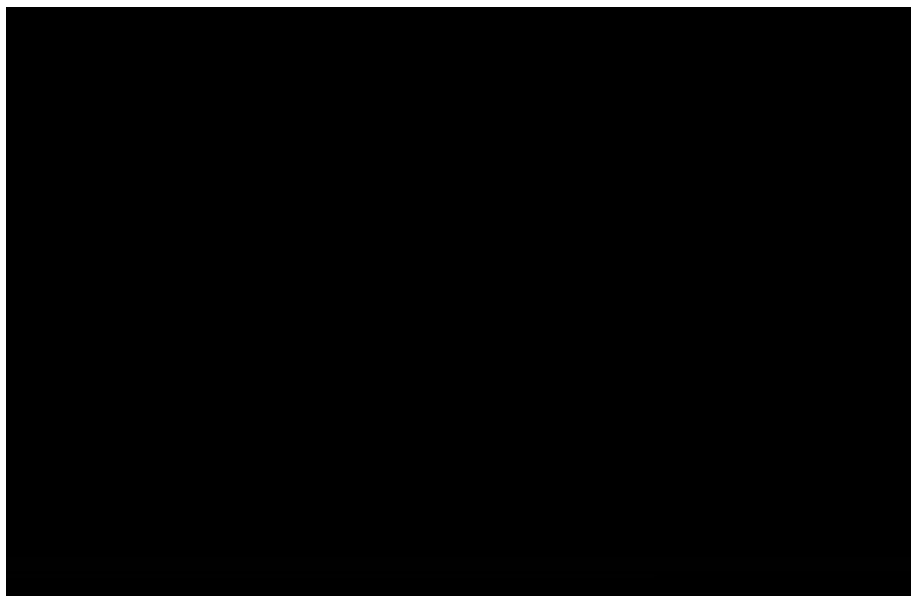
The manœuvre of the able commander of the Dordogne is worthy

of imitation, but how is one to know of the approach of the storm? By winds from the eastern quarters fitful in force and direction; by the abnormal gyration of the breeze; by a marked fall of the barometer; by the cirrus overspreading of the sky. We do not hesitate to say that the latter indication is perhaps the best.

Whether the cirrus are the causes or effects of cyclones; whether they are incited by the inflow of humid air into the central section, which on rising in the upper regions becomes cooled and then pours down over the periphery; or whether they are the source of an active agency and electricity on which these meteors feed—is a matter of little importance to us. What is far more interesting is to recognize them in time; for their intrusion in our immediate atmosphere, to which they tend by law of gravitation, will cause abundant precipitations, and it may happen that when we wish to examine the sky it is covered by a veil of low clouds.

For two years past we have studied attentively on the coasts of France the cirrus formation, and we can affirm that there is no better forecast, including the barometer, of storms, gales with rain, hurricanes, and bad weather in general. The abundance of coming rain and the violence of the wind may be reckoned by the apparent thickness of the layer of the cirrus; even in summer, when the fierceness of the sun's rays dispels the clouds, we have never observed a non-concurrence between the appearance of small, white, dense, and very high clouds and the subsequent coming of atmospheric disturbances.

RÉSUMÉ AND CONCLUSIONS.



Independently of those two rotatory motions, the winds in the extra-tropical belts generally vary from north to south passing through the west, or inversely according to the hemisphere. These motions are due as much to the rotation of the globe as to the tendency towards the algebraical equilibrium of the impulsions of the air.

SELECTION OF A SAILING PARALLEL.

The first problem to solve for a captain on a long eastward voyage is the selection of the parallel he intends to follow. Without declaring ourselves in favor of this or that latitude, we shall simply remark that there exists a direct relation between the energy, the frequency of the anti-trade upon a given parallel, and the corresponding acceleration of the barometric curve; the greater this acceleration, the more numerous the chances of fresh breezes varying from the distant pole to the west. In crossing the Indian Ocean or the South Pacific we should then advise the selection of the belt in which the fall of the barometric pressures is most steep. With this idea in view, it will be found necessary to ascend at least as high as the 42d parallel, and avoid the zone comprised between $46^{\circ} 30'$ and 50° .

CONCLUSIONS.

Once the route parallel determined upon, the captain need pay no attention to the gyration of the winds so long as they are favorable; he must take as much advantage of them as possible in reaching his destination. But if fortune should turn and he meet with adverse winds, several contingencies will present themselves. If the east breezes are feeble, the thermometer remaining high (see the mean on the curve), there is no cause for fear; those breezes will not last, and will soon become western after passing through north. If the winds are persistent, irregular in violence and direction, and accompanied by a marked fall of barometer, and if at the same time the sky becomes overspread with very high, small clouds, make ready for a revolving storm with winds from the eastern quarters at the outset.

When the cyclone reaches you, either the winds at the outset will be very near northeast, in which case you are in the so-called dangerous semicircle, and you must bring to on the port tack to await patiently until the breeze, which is bound to veer to north and then to west, has become sufficiently favorable to allow you to steer your course, or else the winds at the outset will be nearly southeast. In the latter case you are in the manageable semicircle, and you may

sail to the north of the disturbance, where you will find favorable winds. You will have to round the cyclone on the west by standing to the north (perhaps one or two points west of north, in case the winds should delay in veering south); keep the breeze broad on the quarter, hauling course to starboard as the wind veers aft, until you are steering your course with winds varying from southwest to west. Finally, if with the winds southeast at the outset you find yourself unable to sail north, bring to on the starboard tack in order to keep the ship's head to the sea, and ride as easily as possible.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ADDRESS OF HON. JAMES R. SOLEY,

Assistant Secretary of the Navy,

ON THE OCCASION OF THE UNVEILING OF THE JEANNETTE MONUMENT AT THE UNITED STATES NAVAL ACADEMY,
ANNAPOLIS, MARYLAND, OCTOBER 30, 1890.

We have come here to-day to pay the final tribute to a little band of officers and seamen of the Navy, who, nine years ago, gave up their lives, in a toilsome and difficult enterprise, an arduous labor of exploration and scientific research. It is a date well chosen, for it is the anniversary of the day upon which closed the record of their undertaking. They entered on their task with no certain prospects of success, sure only of the perils and difficulties they were to encounter, and looking for no reward save that which comes from the consciousness of duty done. Their expedition made its contribution to our knowledge of the lands within the Arctic circle, but, like so many others that had gone before it, failed of its great and ultimate purpose. But this same expedition, failure though it was in its attempt to penetrate to the Pole, or even to gain a latitude beyond its predecessors, yet, in its bright example of sustained endeavor, of lofty steadfastness of purpose, of dangers met unflinchingly and hardships borne without complaining, was crowned with a success far surpassing the triumphs of scientific discovery, and worthy of all that we can do to commemorate and celebrate it here.

The expedition of the Jeannette was a new experiment in Arctic navigation. Of the three main gateways to the Pole, only that whose opening was at Behring Strait had been as yet untried. Many were the attempts which had left their record of suffering and

disaster on the shores to the northward of Baffin's Bay. The passage by the North Atlantic had its ardent advocates, and exploration here had reached far north, but had stopped at Franz Josef Land. The pathway leading north from Behring Strait, if pathway there might be, was unexplored. Herald Island was known, and beyond it glimpses had been obtained of Wrangel Land, but whether this half-seen country was a mere dot upon the frozen ocean, or another Greenland stretching in a wide expanse which reached the proportions of a continent, was hardly guessed at. Towards Behring Strait flowed the warm current of Japan, and its influence might perhaps reach beyond the parting of the continents, making a navigable highway through the ice-pack that filled the great spaces around the Pole.

To solve this problem, to penetrate if possible by this conjectured entrance to the farthest north, was the object of the voyage of the *Jeannette*. The enterprise was set on foot by the public spirit of James Gordon Bennett, and sustained and carried out solely by his generous liberality. It was Bennett who gave the vessel in which the new venture was to be made, and who selected the man that was to make it. The leader, Lieutenant George De Long, was a volunteer for the service; indeed, had it not been for his burning eagerness to make the trial, it might, perhaps, never have been made. Already he had served his apprenticeship in Arctic navigation, when, in an open steam-launch, the *Little Juniata*, he made his way across Melville Bay to Cape York in search of the fugitive crew of the *Polaris*. It needed but one interview to convince Bennett that he had found the leader for his enterprise—a man in whom were united



hand, and strengthened to enable her the better to withstand the rude shocks of navigation in the Arctic seas. Her officers and crew, chosen with care and judgment, were gradually assembled; and certainly no ship was ever sent on the perilous work of Arctic exploration with a company braver, more earnest, or more ready in bearing and enduring all things, than that which the *Jeannette* bore away from San Francisco, buoyant with hope, with a confidence born of a high courage and the strength of disinterested purpose, and eager to win success, however great the dangers of the struggle.

It was on the 9th of July, 1879, that the ship sailed out through the Golden Gate of the Pacific, and two months later that she entered the frozen gate of the Arctic, from which she was destined never to escape. Striking, on the 6th of September, a lead in the ice-pack that offered what seemed a fair promise, the *Jeannette* was soon beset, fast in the ice, imprisoned beyond all possibility of deliverance by any effort that she or her people could make. Here she was to remain, frozen in, helplessly drifting with the pack, for twenty-two wearisome months. Of these the first fifteen were hardly months of drift; the movements of a year covered the space of a scant hundred miles. The zigzag course of the ice-floe in which the ship lay cradled was hither and thither by slow, short drifts—here a little and there a little, a step to-day-in advance, a step to-morrow on the one hand or the other, a step the third day back to the point of starting. In November of 1880 observations showed the ship to be in the same spot where she had been recorded in the previous April. "Thus it goes," said De Long in his journal, "east one day, west the next, north one week, south the next. When will this come to an end?" One day's fair steaming in open water would have covered all the explorations of fifteen months of aimless drift.

Do you realize, my friends, what must have been the strain upon De Long and his companions, thrown in upon themselves during that long imprisonment, filling nearly the space of two whole years? Day by day as he rose and looked about him at the dull prospect, outlined only by those frozen shapes which grew monotonous even in their incessant change, struggling against the overwhelming sense of failure, powerless against forces which no human will could master, what cruel discouragements must he have suffered! Month after month rolled by, autumn became winter, winter gave place to spring, spring to summer, and so on through a second autumn and a second winter—a summer and winter, a spring and autumn of the calendar,

marked only by the long gloom of the Arctic night and the unbroken, ice-reflected glare of the Arctic sunlight.

" Thus with the year
Seasons return ; but not to me returns
Day, or the sweet approach of even or morn,
Or sight of vernal bloom, or summer's rose,
Or flocks, or herds, or human face divine ;"—

nought to be seen hour after hour but the wide expanse of the eternal pack, stretching away in dreary sameness to the fog-bound horizon ; no change or prospect of a change ; no compensations even of half-attained success, or satisfying gleams of hope that the ice-drift was bearing the ship one step onward in her course.

How do they bear themselves, these men, who sailed from home full of high hopes and eager aspirations, now that their hopes are crushed and confidence has yielded to the expectation of defeat ? Read the record in De Long's journal, where every day's events are faithfully transcribed,—events so trifling that their magnified importance shows only by heightened contrast the dullness of this dull round of daily existence,—and see how courage and self-devotion can uplift the mind, even in the darkest hours. It is a narrative touching in its manly simplicity and unconscious pathos. " There can be no greater wear and tear," says De Long, in his frank, artless way, " on a man's mind and patience than this life in the pack. The absolute monotony ; the unchanging round of hours ; the awakening to the same things and the same conditions that one saw just before losing one's self in sleep ; the same faces ; the same dogs ; the same ice ; the same conviction that to-morrow will be exactly the same as to-day, if not more disagreeable ; the absolute impotence to do anything, to go anywhere, or to change one's situation an iota ; the realization that food is being consumed and fuel burned with no valuable result, beyond sustaining life ; the knowledge that nothing has been accomplished thus far to save this expedition from being denominated an utter failure ; all these things crowd in with irresistible force upon my reasoning powers each night, as I sit down to reflect upon the events of the day ; and but for some still, small voice within me that tells me this can hardly be the ending of all my labor and zeal, I should be tempted to despair."

All this while the crew are kept at work, busily following the day's routine, and by exercise and occupation keeping away disease and discontent. Their leader never wearies in his task. He guides their occupations, watches their health, sustains their manful spirit. Obser-

vations are taken and records kept; investigation and experiment, narrow as is the field of research, are followed up; the daily work of the ship, conformed to naval regulation and tradition, pursues its course. Each Sunday the Captain reads the service, and once a month, the Articles of War. To-day it is a bear hunt, to-morrow the killing of a seal or gull—trivial incidents, but all that breaks the monotony of life, except when the grinding and tearing of the floes pressing upon the ship serves as the muttered menace of catastrophe that any day may bring. Once at least, during the first winter, the ship narrowly escapes destruction, and all is put in readiness for a retreat upon the ice; but these alarms pass by, and for a twelve-month all is quiet.

The officers and crew are worthy of their commander. In that long imprisonment in the ice-pack, and throughout the five hundred miles of the retreat, each and every one stands out, shining with the light of his own serene courage, his own unwavering endurance. To their virtues the Captain's journal bears sincere and willing testimony. First of all come his two right-hand men, the executive officer and the engineer, of whom he writes: "Aided by Chipp and Melville, whose superiors the navy cannot show, with their untiring energy, splendid judgment, and fertility of device, I am confident of doing all that man can do to carry the expedition to a successful termination." Chipp is the model executive officer; calm and earnest, reserved, always with work to do, and always doing it quietly, steadily, and surely. "He says but little," writes the Captain, "but I know where he is, and how reliable and true." Not less reliable and true are the other officers: Danenhower, the navigator, struck down by an affliction that robbed him even of the poor consolations that might be drawn from that barren life, but bearing his confinement with heroic fortitude and patience; Melville, whom his commander finds "more of a treasure every day, always self-helpful and reliant, a tower of strength in himself"; and last of all, Ambler, the good physician, cheerful and kindly, caring wisely and watchfully for the health of his companions, and brightening their spirits by the gentle influence of his sunny temper. Collins, the meteorologist, and Newcomb, the naturalist, pursue faithfully their vocations, observing, collecting, recording, under the unaccustomed burden of naval routine and discipline. In the next rank come Dunbar, the ice pilot, grave and serious, whose experience proves a help at all emergencies; Sweetman, the carpenter, untiring, ingenious, a sure and constant reliance; and Jack Cole, the

rugged boatswain, whose reason finally succumbed to hardships which his stalwart frame repelled. Equally devoted and capable are the crew, at their head Nindemann, easily foremost, whose energy and self-devotion win from the Captain the highest praise, and for whom, as well as for Sweetman, he asks a medal of honor. For each and all the others, down through the list, to the two Alaskan Indians and the Chinese cook and steward, there is naught to be said but praise; their courage, their patience, their helpfulness and willing obedience, the cheerful front with which they face misfortune, the steadfast resolution that bears them past disaster. "Another crew, perhaps," said one of their officers, "may be found to do as well, but *better*—never."

With the approach of the second winter the drift of the pack took on a uniform direction, and, gradually gathering force, bore the ship slowly to the northwest, traversing during the next six months ten times the space covered in the year gone by. Here was relief at last in progress, no matter whither; and in May the eyes of the ship's company were gladdened by the first welcome sight of land. They called it Jeannette Island. It was a desolate rock in the Arctic, nothing more—grim and unapproachable; but it was at least one point that raised itself aloft, breaking the outlines of the sea of ice, and marking the first result, small though it was, of all the efforts of the explorers. Presently another land opened out beyond it, Henrietta Island, a second barren rock surmounted by its broad ice-cap. This last Melville was sent out to explore, his party moving by boat and sledges over the loose, broken pack. They reached the land and took possession in the name of the United States; for no human eye had ever before this day looked upon the island, or, if it had, no



suddenly opens lanes in all directions, and these as suddenly close when the floebergs, propelled by resistless, unseen forces, are dashed upon each other. Each moment the ship seems on the verge of destruction. For a few hours she escapes, but presently a lane opens where she lies, and for an instant she is again afloat. It is but for an instant. The floes that have been torn apart have only recoiled, as it would seem, for one final spring; and returning, they crush the vessel like grain between the upper and the nether millstone. They hold her fast just long enough for the crew to take refuge on the ice with boats and sleds and stores; and then separating, they leave her, a crushed and shattered craft, to plunge into the depths below.

And now, with the sinking of the *Jeannette*, comes the most marvellous chapter in this strange history. Thirty-three men, with a pack of dogs, three boats, five sleds, and sixty days' provisions, cast upon the drifting pack, started forth to reach the land, five hundred miles away. Never was there such a retreat as this. The nearest point on the Siberian coast was the Lena Delta. Between it and them lay three or four islands, the New Siberian group; but except for these, only a moving pack, and a stretch, how great or little none could say, of open water.

No time was lost. De Long, still strong in his steadfast faith, supported loyally by officers and men, organized his band, assigned to each his duties and his post, and after a few days' careful preparation, setting his face southwards, began the weary march. Each day the pioneers laid out the route, and sleds and boats were drawn over the ice to the determined point. The work was work with sleds and ice, but not the sleds and ice of a boy's winter sport. There was no child's play in clambering over these distorted hummocks, dragging up and down the great whale-boat and the cutters, and sledge-loads of provisions, or charging across the moving floes, leaping from one to another as the intervening leads were opening or closing, often with barely time to escape from one uncertain foothold to a second hardly less uncertain. Their first week was a week of cruel discouragement—of sickness and distress, of mishaps without number, of toilsome struggling with heavy loads over rough masses of broken ice, which opened in wide cracks and lanes of water almost beneath their feet. The progress made was less than a mile a day, and even this must be passed and repassed, with load after load, boats, sleds, provisions, sick, until the whole had been dragged, ferried, tumbled

into place. And when, at the week's end, the Captain obtained an observation, he found that the ice-drift had brought all to naught, and far outrun even their painful efforts; so that, instead of five miles to the south, the seven days had sent them thirty miles to the northwest.

Only to Melville and Ambler did De Long make known his secret. The others were allowed to remain in happy ignorance that all their labor had only made their case more hopeless. Still they plodded on towards the southwest, now over great blocks and ridges, now upon sliding, shifting floes. One day the ice would be in motion all about, swinging and swirling this way and that, opening in their path broad lanes of water only to be traversed by ferrying in the boats, or by flying bridges made from the floating cakes. Another day they would cross a stretch of confused floebergs, which was the hardest work of all. Another would find them floundering through deep snow, and ponds and water-holes, tired and wet, with footgear worn to shreds, but, ever struggling to reach the open water which they knew must be somewhere upon the ice-pack's outer edge.

So for five weeks they continued their slow advance, making good little more than a mile a day. But the ice-drift was now helping them, and pushed them onward two miles while they were marching one. So that at least there was something for hope to feed on during this dreary time; and still more courage came to them from the sight of land ahead. It cost them eighteen days of toil to reach it, and at the last they were nearly carried past it by the swift currents; but, charging with a rush across the broken floes, they leaped the last space and landed safely on the ice-foot.



were whirled along in the swift current, surrounded by the whirling floes, and found themselves at last upon the open ocean.

The dangers of the past were now forgotten. Resting a short space at the islands, De Long with his three boats headed for the Lena Delta, whence he might make his way southward to the Russian settlements. One more stop was made at the Island of Semenovski, on Sunday the 11th of September. It was the last time that all would be together, although they knew it not, and De Long, as was his wont, held divine service and read the Articles of War. On Monday morning all embarked and sailed with prosperous breezes until the afternoon, when the wind freshened to a tempestuous gale. As night came on—a fearful night in which it seemed as if no boat could live—the three crews, which had for two long years faced together the perils of the Arctic, were driven apart, never to meet again.

Of Chipp, the generous and devoted first lieutenant of the *Jeanette*, and his people in the second cutter, the last that was seen was on this night, when the others parted from them, struggling in their little boat against the fury of the tempest. What happened to them no man knows, for months of tireless search in every nook and corner of the coast failed to reveal a trace of what might have been their fate. For them we must believe that no morn ever broke upon that night of horror.

We do know that the whale-boat, a stauncher craft, was only saved by the skill and vigilance that guided her movements through the perils of the storm. At daybreak she was still uninjured, and a wise foresight directed her to the eastward along the coast into the great bay that receives the southernmost of the Lena's outlets. Here three days of chance sailing in passages among the Delta islands brought Melville and his party to the native settlements, where, as their force was spent, they landed and found rest and shelter that slowly brought them back to health and strength.

The first cutter, in which were De Long and Ambler with Collins and eleven men, survived the night, though losing mast and sail. Moving with difficulty in their disabled boat, they only reached the coast on Saturday, when they grounded at the Delta's most northern point, and near the mouth of the main northern outlet. Wading ashore through the thin ice that for a mile seawards covered the shallow beach, they landed with their instruments and records, and with four days' scant provisions, set out on their southward march.

It was a cruel fate that marked out De Long's landing place. The Lena Delta in October is a desolate waste, snow-covered, a labyrinth of intersecting streams, impassable to boats by ice, but ice as yet too thin to bridge them. From the landing place on the north coast to the Delta's head, where the river branches out to its divergent mouths, a space of eighty miles in a line due south, there is no human habitation. The point that Melville reached lies far off to the southeast. Along the coast a little way, not more than thirty miles from where the cutter stranded, is another village, the northernmost of the winter settlements. But of this village De Long knew nothing. His wanderings, and the untiring searches that others made to find him, have mapped out for us the lands and waters of the Delta, but to him, at landing, they were all unknown. His map, if map it could be called, had names that seemed the names of places where men dwelt, but they were blind guides. They pointed out only one hope, that by following the main river and going south, he would in time reach a settlement. Of habitations to the west, along the coast and within easy reach, they gave, alas, no clue.

So with the same unfaltering resolution which had carried him, and those whose lives rested upon his word, through so many perils, he started with them on the southward journey. The long confinement in the boat, the hardships and exposures of the retreat, had sapped their energies, and they were in no condition for forced marching. One of the men, Ericksen, crippled and weak beyond his fellows, kept all the party back, when every moment was vital to their safe deliverance. Tenderly they cared for him, waited for him, carried him, weak as they were, when he could no longer walk him-

It tells how hopes were raised by tracks of deer, by footprints of men even, only to be blasted, for, as mischance would have it, natives had gone that way but a few days before, and others found the records of the band after De Long had passed. It tells how, after three weeks of unsuccessful effort, the Captain sent Nindemann and Noros off for succor; how for ten days thereafter the main body struggled on, hoping each day that the expected help would reach them; and at last, how for ten days more, unable to move, having reached the parting of the streams at the Delta's head, they waited, giving up one by one, until only the Captain and the Surgeon remained alive. And then the record ceases.

Read the piteous story of these last ten days, the final ending of that glorious retreat, which had lasted one hundred and thirty days since the ship went down—a story of little else than death:

"Friday, October 21st—131st day. Kaack was found dead about midnight between the doctor and myself. Lee died about noon. Read prayers for sick when we found he was going.

"Saturday, October 22d—132d day. Too weak to carry the bodies of Lee and Kaack out on the ice. The doctor, Collins, and I carried them around the corner out of sight. Then my eye closed up.

"Sunday, October 23d—133d day. Everybody pretty weak. Slept or rested all day and then managed to get enough wood in before dark. Read part of divine service. Suffering in our feet—no footgear.

"Monday, October 24th—134th day. A hard night.

"Tuesday, October 25th—135th day.

"Wednesday, October 26th—136th day.

"Thursday, October 27th—137th day. Iverson broken down.

"Friday, October 28th—138th day. Iverson died during early morning.

"Saturday, October 29th—139th day. Dressler died during night.

"Sunday, October 30th—140th day. Boyd and Goertz died during night. Mr. Collins dying" * * *

The pencil drops—the eye is glazed, the arm is palsied, the fingers stiffen and grow cold. The fight has been fought, the struggle is ended. The others, one by one, have passed away. There is no more that human effort can accomplish.

"O, let him pass! He hates him,
That would upon the rack of this tough world
Stretch him out longer."

De Long and Ambler lie side by side. We know not to which of them first came the whispered summons of the death angel, but we know that they were the last to answer. What was it, think you, that made these two hold out to the last? Was it that they were made of tougher fiber, endowed with greater health and vigor—greater than their seasoned shipmates, the hardy seaman, the Alaskan hunter? I think not. It was that in them lay that unconquerable purpose to keep their charge, to fulfil, even to the bitter end, their sacred trust. And thus it happened that De Long, his brother officer still faithful at his side, only surrendered his commission when the Almighty had disbanded his command.

There is more yet to be told of this expedition, but we may not dwell upon it here: how Danenhower first attempted a desperate search for his lost companions; how Melville heard from Nindemann and Noros of his Captain's cruel plight, and how, before he had regained his strength, he braved alone the Arctic storms and cold and hunger, traversing the Delta down to the very coast, freely putting his life again at hazard, in the faint hope that he might bring relief; how a second time he scoured the plains in March, and found the bodies, and, laying them in the earth to rest, built over them the cairn and cross, in whose likeness this stone has been erected here; how the Russian Government, faithful to its old tradition of friendship, lent its aid freely to the explorers; how the later relief parties came out, and how the generous patron of the expedition gave lavishly of his time and fortune to carry on the search and to lighten the sufferings of the survivors. But it is not of these things that we are speaking here and now. It is not to the living but the dead



It matters not whether their bones lie here, or at their homes, or on the bleak Siberian coast, where they gave up their lives; "the whole earth," said Pericles, "is the sepulchre of illustrious men." But it is fitting that here should be their monument. It stands here for us Americans, who hold our Navy and our Country dear, as a memorial of what her sons have done, and as an earnest of what they will do hereafter. It stands here for you, the comrades of those young officers who fell, to give you added strength and courage, when you too find yourselves the victims of relentless fate, and driven to the edge of the black chasm of despair. It stands here, last of all, for you, Cadets of the Navy, that daily you may have before your eyes this bright example of heroic virtue—virtue which in the past has been the pride and glory of your Service, and which it will rest with you to transmit in undimmed luster to the generations yet to come.

Heart-rending as is the burden of that song, borne to us upon the wings of the Siberian wind, it is not the mournful music of defeat. As with their great Norse ancestors, the sea-heroes, the death-chant of our own sea-heroes rings only with a joyous strain of triumph; and in their triumph we triumph also.

"Pæans, sing high! What would we with a dirge?
Proudly we weep our brave."

There they stand, the martyrs of the *Lena Delta*, the men, who, through high courage, overcame disaster; surrounded by that goodly company of brave explorers, whose memory, like theirs, remains enshrined within these walls—Collins, a victim of the poisonous miasma of the Isthmus; Strain, perishing from hunger and fatigue under the burning sun of the tropics; Talbot, sailing in his open boat over fourteen hundred miles of the Pacific to bring succor to his shipwrecked comrades; and Herndon, issuing unharmed from the perils of the Amazon, but yielding his life, a cheerful sacrifice, to save the passengers upon his sinking ship.

There they stand,

"with the rays
Of morn on their white shields of expectation,"

illumined by the brightness of their own imperishable fame, serenely waiting for the final muster; while from the chorus of uplifted voices come the ringing notes of an *Io Triumphe*, re-echoing throughout all the ages, proclaiming in eternal harmonies the glory of those who fought their fight out to the end, and who, through death, achieved undying victory.



PROFESSIONAL NOTES.

TARGET PRACTICE AT THE NAVAL ACADEMY.

BY LIEUTENANT-COMMANDER C. S. SPERRY,

Head of Department
of
Ordnance and Gunnery.

U. S. NAVAL ACADEMY,
ANNAPOLIS, MD., *March 24, 1890.*

The competition for the marksman's badge for small-arm firing shall be governed by the following rules :

1. It shall not be awarded to any one who has not fulfilled all of the following conditions contained in the circular of the Bureau of Ordnance, May 25th, 1889, regulating target practice in the service.

2. " While on shore, firing the service rifle, with service sights and ammunition, at an A army regulation target, 170 yards distant, make 30 out of a possible 50, with 10 consecutive shots, all fired within a period of 7 minutes. The position of the firer during this practice must be standing and without artificial rest.

3. " The firer being in a boat which is afloat in smooth water, do the same thing, except that the position may be any desired ; an artificial rest may be used, and the score to be made shall be 15 out of a possible 50.

4. " While on shore, put 4 out of 6 shots fired consecutively from a service revolver into a surface the size of the bull's eye of the army B target (or into a rectangle 24 inches high by 18 inches wide) at 30 paces range, within 1½ minutes."

5. The firing of the Third class, in the Spring, will be at a range of 170 yards at the army A target.

6. The firing of the same class during the Summer, with the rifle and revolver, will be at the ranges, and under the conditions, of paragraphs 2, 3, and 4.

7. The badge will be awarded as soon as possible after the commencement of the term to the cadet of the Second class who has fulfilled the above conditions, and whose total score for the Spring and Summer practice is the highest percentage of his possible score.

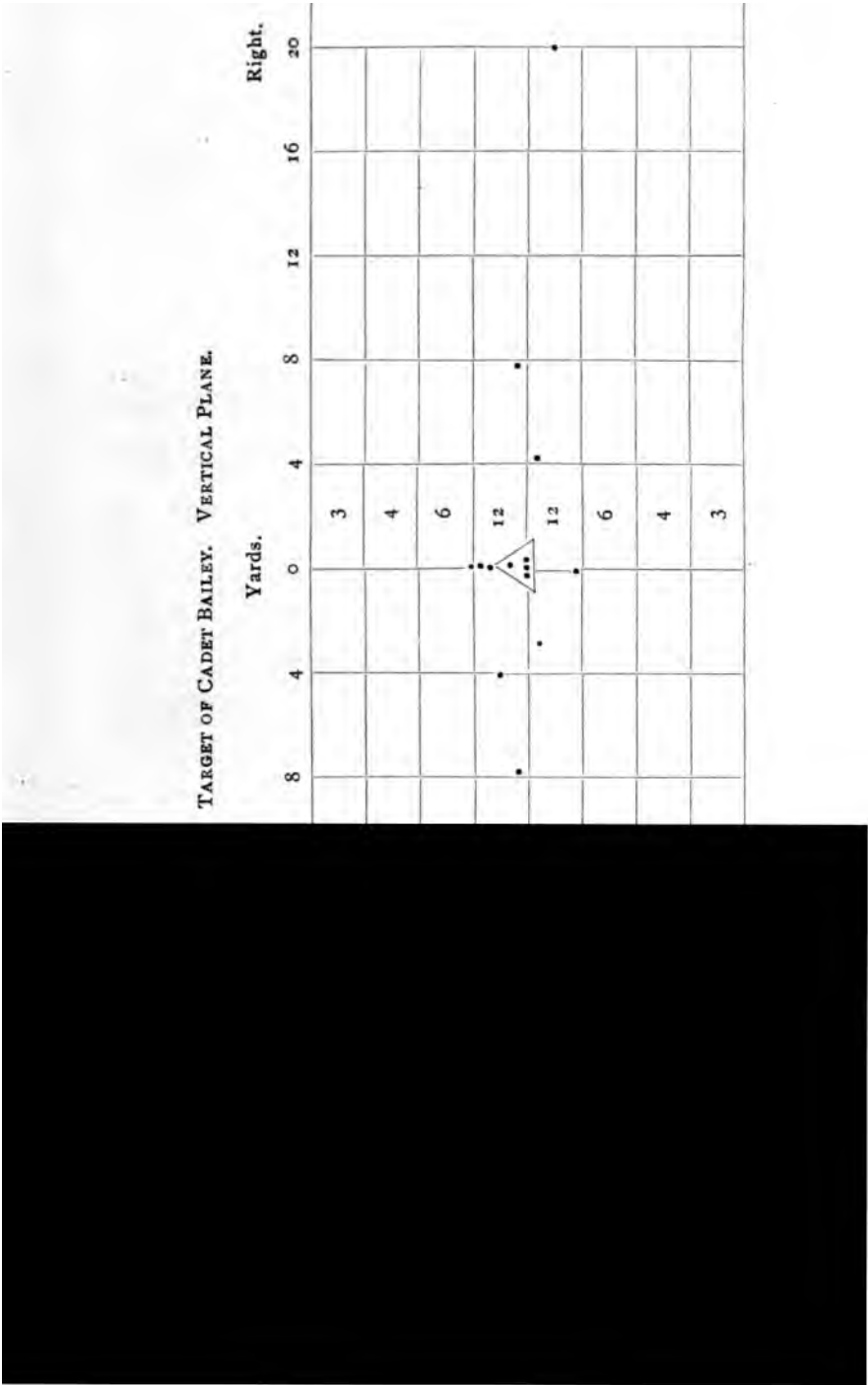
8. In scoring the revolver practice, all hits within the bull's eye shall count 5, and all other shots shall count 0.

9. The percentage under paragraphs 2, 3, 4, and 5 shall be calculated separately and added.

10. In case there is a tie, it shall be decided by firing one or more groups of 10 shots, as may be necessary for a decision, under the conditions of paragraph 2.

W. T. SAMPSON,
Captain, U. S. N., Superintendent.

In the Spring of 1890 medals were offered by the Superintendent to the cadet of the First class making the best score with the Hotchkiss rapid-fire guns, and to the cadet of the Second class making the best score with the Hotchkiss magazine rifle.



The first medal was awarded in June to Cadet Bailey.

The firing was from the Standish, at the service great-gun target, the range being determined by trial shots. Cadets Bailey, Coleman, and Schofield tied in a score of 138 out of a possible 144. Upon shooting off the tie, Cadet Bailey won, having fired 22 shots—12 at 1400 yards, 5 at 1050, and 5 at 950, scoring 258 out of a possible 264, with 4 direct hits. The firing was upon several different days. At the target practice from the Wyoming, before the Board of Visitors, Cadet Bailey showed that his success was not accidental, by hitting the target several times at 1000 yards with a 32-pounder smoothbore.

The average of the entire First class was 75 per cent of the maximum score on the service vertical target, and at the examination drill alluded to, the target was struck eight times by the heavy guns, Cadet Latimer finally sinking it with a shell from the 8-inch M. L. R. when only a corner of one wing showed above water. The range was determined by Cadet Coleman with the 1-pounder R. F. gun with great accuracy, his shots frequently striking the target.

Each cadet fires during the Second class year five rounds from a heavy gun, and during the First class year about twenty rounds. This amount of practice does not seem sufficient to account for such accurate firing, and it is believed to be due to the steadiness engendered by the constant use of ammunition at all company and battalion drills, as well as to small-arm range practice. Volley firing by company and battalion at a target certainly cultivates nerve. There is no more effective safeguard against accident with arms than the constant use of blank or other ammunition, and it is an open question whether the dummy cartridge is not useless and dangerous. A blank cartridge, if the arm is not properly handled, will betray carelessness by its explosion with comparatively little danger, but the harmless dummy tells no tale, though the ball cartridge, from which a careless person will hardly distinguish it, most certainly will.

Thousands of the cartridge shells can be reloaded as blanks with a small charge with very little trouble and expense, and are invaluable in teaching care in the use of ammunition and steadiness in firing.

The competition for the small-arm medal is in progress.

NAVAL ATTACK ON A PROTECTED HARBOUR.

BY COMMANDER EGERTON, R. N., H. M. S. Orlando.

(Reprint from the Journal of the United Service Institution of New South Wales.)

“What is a protected harbour, why do we protect a harbour, and what is it protected against?”

The first of these questions—“What is a protected harbour?”—can be easily answered, for it is merely a name given to a harbour which is defended by guns, torpedoes, or vessels of some kind—perhaps one, perhaps the other, perhaps a combination of each—but which cannot be called a fortress, and cannot in any way compare with such places as Portsmouth, Portland, Cherbourg, Kiel, or Cronstadt and many others of similar importance, where nature and the skill of the engineer have done so much to render them strong that nothing short of a powerful fleet of ironclads would ever dream of attacking them; and even after weeks, or perhaps months, of most persistent and severe fighting, at enormous cost, the result would be doubtful.

There are numbers of harbours which are protected by guns and so on, some more, some less, according to the value of the property behind them, either from a strategical or monetary point of view. Such harbours abound around the coast of the British Isles and the Colonies, such for instance as Falmouth,

Holyhead, Belfast, Dundee, Peterhead, Aden, Singapore, Sydney, Melbourne, Hobart, Wellington, and so on. These are protected harbours.

The next question is, "Why do we protect a harbour?"

This seems to be a plain question, but I am not sure that it has been very clearly answered. All harbours are not protected, and many are only protected by one or two guns, and yet the value of the property, of which the harbours are the doorways, is very considerable; and why has it only of late years occurred to people's minds that their harbours should be protected? As a proof that this is really the case, it is only necessary to contemplate the enormous sums of money which are *now* being expended for the defense of imperial ports and harbours. They have been needed just as much for years past as they are now. The only answer that seems to me to meet the case is that in years past it has been assumed that the navy would protect the harbours; and I think that the naval manœuvres which have taken place for the last few years at home have done much good in bringing it home to the people's minds that it is very easy for a squadron of five or six ships to slip past another on the lookout for it, even in such narrow waters as the English Channel. It is true they may not be left unmolested for long; but it does not take very long, with modern ordnance, to do incalculable damage.

Many people think or have thought that in the event of war a ship or ships would be told off to protect their harbours for them, and the more the value of the property (private property, mind you), the larger would be the force told off to protect them. I do not think this would or could be the case; surely an admiral would not weaken his squadron by dividing it up into small bits and placing a bit here and a bit there. No: the defense of the harbour is not the function of the navy; we are meant for attack of ships more particularly, but still sometimes it may be forts. We are not trained to defense in its passive form. We never practice *with* the military, to whom the defense is entrusted, and, with the exception of some half-dozen coast-defense ships, we are not prepared for it; we are of little use boxed up in a harbour, and our place is at sea. It would be more economical, more permanent, and more satisfactory in every way to mount guns on shore than to place them in a ship which has the disadvantage that it can be sunk and cannot be hidden, without having any counteracting advantages, since there is not room for the ship to move about.

To defend the approaches to our channels and harbours is quite another thing, and is most decidedly one of the functions of the navy; here we have scope to move about, and can use the powers with which we are furnished to their best advantage, and if we are in sufficient numbers and do our work thoroughly, the ports or channels we are protecting may not have to fire a shot.

It would seem, therefore, that the real object of protecting a harbour is to delay the enemy until succor arrives. That is, the enemy, having slipped past the protecting squadron, arrives off a port; he has double or treble the number of guns that are mounted on shore; but what the defense has to do is to delay him as much as possible to prevent his bombarding the city, town, depot, or whatever the property may consist of; to prevent his levying enormous sums of money, to prevent his finding shelter for his ships or replenishing them with coal, ammunition, or provisions, until succor arrives. The aim, then, of protecting a harbour is to delay the enemy. Hence our business in attacking a protected harbour is to do our utmost to take it as speedily as possible, knowing that delay to us means most probably defeat.

The third question is, "What do we protect a harbour against?"

Opinions on this question will vary much, no doubt, and therefore there is no harm in raising it, as it will lead to discussion, which is always useful. If a harbour aspires to beating whatever enemy may be brought against it, without any regard to a protecting navy, then I ask where is the line to be drawn? for, if a harbour is protected against a possible enemy of (say) four cruisers, and six are sent against it, what is to be done then? You cannot call out, "It isn't fair, I won't play." You have disregarded or thrown over

the protecting navy, and so you cannot hope for succor in that direction, for they may possibly throw you over; so where do you draw the line between a light battery and a first-class fortress? The first may defeat a fillibuster or armed cruiser; the second says, "Come, if you dare." But if it be accepted that the object of protecting a harbour is to delay the enemy, then the amount of that protection will depend upon the naval force protecting the approaches to your coast, the area of seaboard they have to cover, and the distance you are from the base of a possible enemy. On this station the first is not as large as it ought to be, but provision has been made for this, and more ships are to be added; the area of seaboard is enormous, which means that you should be better prepared to delay an enemy for a longer time than ports in the English Channel, for instance; and, on the other hand, you are a long way from the base of a possible enemy, New Caledonia being, I think, the nearest possible base, which is at a distance of 1100 miles.

Before attacking a harbour we should carefully consider what resistance we might expect to find. The natural outline of a harbour or haven has so much to do with the defense which may be expected to be met with, that any harbour to be attacked would have to be considered on its own merits; but, as a general rule, wherever a harbour or haven exists we may expect to find submarine defenses, and we shall endeavor to find out beforehand whether these are kept constantly in position, whether they are real or only on paper, and whether, if our attack is sudden, we may expect to find them laid down at all. All this information we should look to our Intelligence Department to supply. We shall expect to find an inner series of batteries so arranged as to bring a heavy cross-fire on the mine-field, and which will hamper our movements over every inch of ground we gain towards our final goal. There will be outer batteries to harass us and prevent our making arrangements for the attack on the inner defenses without a struggle, and also to prevent our lying off to bombard the town, arsenal, depot, or whatever it may be which is being protected. These outer defenses will have to be silenced before the more serious work of attacking the inner defenses can be attempted. We may safely reckon on meeting all this, because it is generally admitted that, with sea room, forts alone will not stop a fleet. The inner defenses will give us the most trouble, and the deeper they are, the more trouble they will give us, because we shall be confined in our area of movement, and every defended yard will mean delay, which, for reasons I have given, we particularly wish to avoid.

There is yet another obstacle which will give us much anxiety and which we may reasonably expect to encounter. I mean torpedo-boats.

Experience has shown that a purely passive defense is rarely successful, whether on land or at sea. No entrenched camp would be left without outposts to watch the approach of an enemy, or without sorties to harass him when he has made his appearance, and this can best be done by an active naval force and a good supply of torpedo-boats. They are as useful as cavalry for scouting. They are dreaded at nights. The terrible weapon they carry and their power of continuing in flotillas render them in every way a most powerful and necessary item of the defense, and so we must be prepared in our attack to guard against them. Therefore, having given the defending fleet the slip, we proceed to do our work of destruction on a harbour which we know to be defended by an outer line of batteries, a deep submarine defense, an inner line of batteries guarding the submarine defense and inner harbour, and, lastly, torpedo-boats.

The nature and number of vessels sent to attack a protected harbour will, of course, depend upon the individual harbour to be attacked, its natural formation, its armament, its probable submarine defenses, the depth of those defenses, the depth of the water, its distance from succor; and, perhaps most important of all, the general opinions of the fighting qualities of its defenders, their numbers, their training and their amount of practice and organization will all influence this discussion; but I think that this work will generally be

relegated to cruisers, as ironclads will not be available. These cruisers will be fast ships, with a large coal capacity, a good armament, and a certain amount of protection. And I propose to say a few words on a modern cruiser, and will take for my type a belted cruiser such as the Orlando, with which most of you are familiar—a ship which would be admirably suited for work of this description.

The Orlando is 300 feet long, 56 feet beam, and 5600 tons displacement, with a maximum draught of 23 feet, and is capable of steaming at a speed of nearly 18 knots for a few hours, and has a radius of action of 4500 miles at 10 knots. She is built of steel throughout, and by referring to the diagram you will see that all the vitals of the ship are protected. The protection consists of a belt of 10-inch armour, steel-faced one-third of its thickness, 200 feet in length and 5 feet 6 inches in depth, about 18 inches being above the water-line at a load draught. On the top of this belt, and resting upon it, is a steel deck of two-inch plates, that is, two inches thick, going the whole length of the ship, being increased to 3 inches at the extremities where the ship is unprotected by armor, and taking a shape thus — — — — — running down towards the ends and assisting very materially to strengthen the ram and take the thrust. Everything that is vital to the ship is kept below this armoured deck, and every hatchway through it is protected by a water-tight door of the same thickness. Below this deck are the bunkers and double bottoms, all of which assist to protect the engines and other important items. Above the armoured deck are the upper bunkers, about 17 feet broad, and running the whole length of the engines and boilers. These, when filled with coal, offer a good protection. The ship above the armoured deck may be riddled and the water wash freely over it, but it cannot get below on account of the water-tight doors before mentioned; and also around every hatchway are high coamings, 3 feet high and 9 inches broad, called coffer-dams. Another noticeable feature in the ship is that instead of having stanchions to support the guns, conning tower, and heavy weights above (and if one is shot away renders excessive strains on the remainder, which may fail to support the weight), they are supported by steel bulkheads, which have the advantage that they may be riddled with holes but will still support much weight. All the guns are protected by 1-inch steel shields. The conning tower is 12 inches thick, one-third of which is steel. From this tower the ship can be steered; guns, engines, magazines, and every part of the ship communicated with by means of voice-pipes and telegraphs; the guns and torpedoes can be fired by electricity from the directors, and the whole of these telegraphs and voice-pipes are carried down through an 8-inch armoured tube, being a solid tube of 24 inches bored out 8 inches in the center. The wires leading to the guns are kept below the water-

PR

The guns mounted variously for protecting the harbour are :

4	9.2-in.	} B. L. R.
20	6-in.	
20	Q. F.	
20	machine	
8	7-in.	} M. L. R.
2	9-in.	

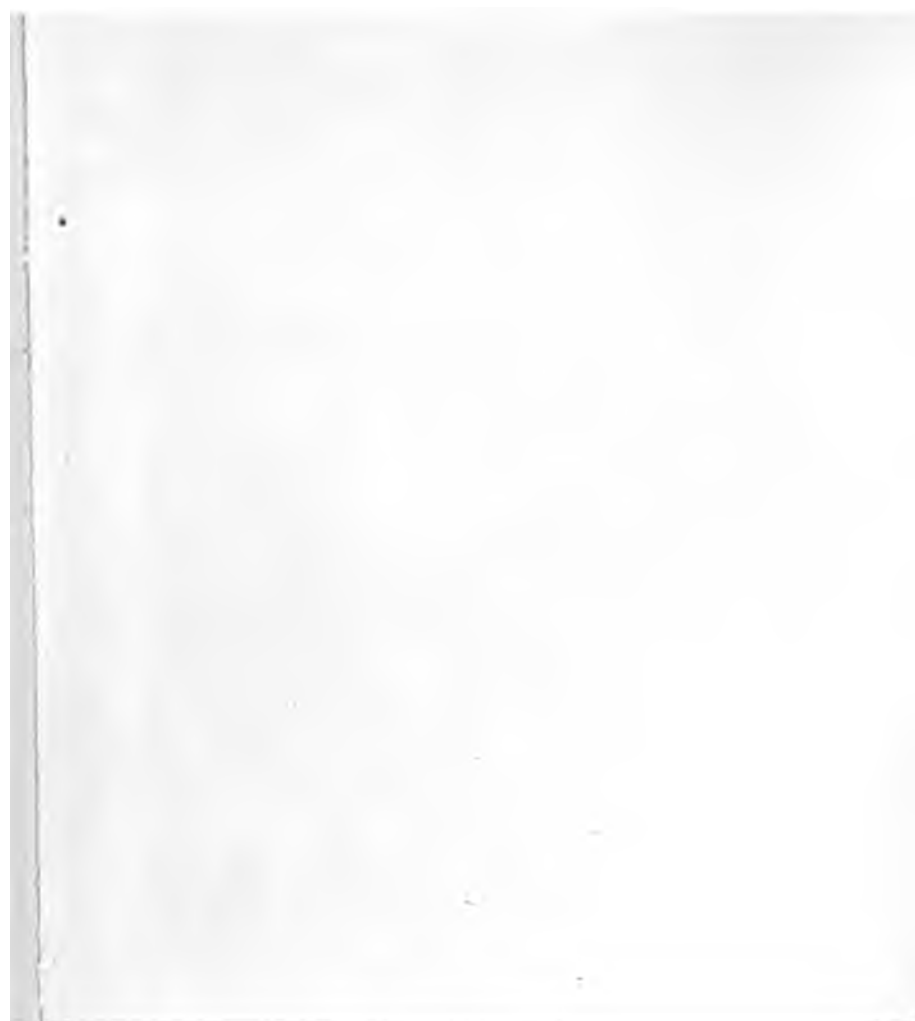
—
74, and 4 torpedo-boats.

A general outline of the attack may be something of this sort :

The Admiral-in-command will arrange his movements so as to be off the port at daylight, so that he has a fair prospect of being able to get almost within striking distance without being seen or signalled. He will have communicated to his captains the exact nature of the tactics he intends to adopt, and everything will be ready for immediate action. He forms his four large ships, not into single line ahead, because a shot missing one ship might strike the next astern, and also because, as he intends to attack end on, the leading ships would mask the fire of others; not into single line abreast, because the broadside of the inner ships will be masked by the outer, and he might be enfiladed by another battery; but he forms into quarter line, *i. e.*, each ship four points abaft the beam of the ship next ahead, in which formation he has his right-ahead and broadside fire clear. He will not form in quarter line to port because a ricochet might then strike his sternmost ships, but he will form them in quarter line to starboard, so that a ricochet, which always goes to the right, would be clear of all his ships; each ship in this formation is on a different bearing and at a different distance to the others. In this formation he steams at a speed at which he will not have to force his engines, and which all his squadron can maintain for a time without fear of straining anything; this speed will be about 15 knots, at which rate he will cover 500 yards a minute, and, allowing ample time between each round, he can make certain of being able to fire one round per gun every 1000 yards, *i. e.*, every two minutes. He will detach the two smaller vessels, which carry six 6-in. guns and ten quick-firing guns each, to harass the two outlying batteries by keeping up a rapid fire on them with his quick-firing and machine guns, and prevent any man daring to expose himself above the parapet or in any exposed positions for sighting his guns or using range-finder. He will select some well-defined bearing on which to steer, and will have noted down certain positions on this line, which he will find by a cross-bearing and from which he has measured off accurately the distance of the batteries on the chart, so that he can elevate his guns with very fair precision. He will probably open fire with his 9.2-inch guns at 6000 yards or so, and with his 6-inch at 5000 or 4000, reserving his fire as each gun is loaded until his bearing comes on, when he knows that his distance is correct. He will approach in this manner to about 2000 or 3000 yards, depending upon circumstances. When the water is deep, and rough weather frequent, a systematic mine defense is difficult; the area to be defended is so large, and the ships may approach in so many uncertain paths, that unless previous definite information has been obtained of the existence of mines so far at sea, he would not be afraid of them, and would manœuvre his squadron to the best advantage to develop their gun fire, knowing well the difficulty of maintaining even a small group effective so much in the open; but correct information with regard to the mining matters is always the most difficult to obtain, especially when it can be confined to some half-dozen persons to say whether real or dummy mines have been laid. In our attack here the Admiral thinks it more prudent to alter his course when between 2000 and 3000 yards off, which he will do immediately after firing a broadside, under cover of the smoke. He then alters course together to starboard, and drops back into a 2-point bearing formation, because, had he retained the 4-point bearing forma-

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tion, his ships would show an unbroken line to the fire of battery A. As he approaches a 2000 yards range, he gets into single line ahead, so that in case of accidents, if one ship should be blown up by a mine, the next will probably escape, and when one has passed, the next may pass, probably. By this time he has warmed up to his work, and so have the defense; they are within a good shooting range of one another, and the whole of the guns will bear; perhaps the men are getting a little excited as the fire improves, so now he orders Director Firing, a system used extensively in the navy, and which I will endeavour to explain.

The distance at which it is intended to deliver the fire being accurately known, the elevation due to that distance is previously given to the guns. The bearing of the battery from the ship when at that distance being also known, the guns are trained on to that bearing;—all this is capable of accurate arrangement beforehand. The guns are joined up for firing by electricity, and the firing-key is in the hands of the officer at the *director*. This instrument is simply a telescope converged and securely clamped on the same point and at the same distance as the guns. Everything is perfectly quiet except the ship, which is bowling along and gradually bringing the cross-wires of the telescope on to the selected batteries. As the point passes the cross-wires, the whole of the converged fire is delivered electrically simultaneously, and the result is according to the care with which the guns and instruments have been placed in the ship, and according to the accuracy with which the bearing, distance, and speed, which have been estimated beforehand, have been adhered to. This firing has been expressly designed to meet the case of ships passing moderately close at high speeds. If, instead of a fort, it was another ship we were engaging, each travelling (say) 12 knots, the space of time required to pass over each other's arc of broadside fire at a distance of 1000 yards would be about 2 minutes. Letting each gun fire independently would be ineffective, as half the guns would never fire at all, owing to the smoke of those which were firing, and owing to the difficulty experienced by the captain of a gun in training on to such a rapidly moving object. The confusion of each gun firing separately is avoided, and perfect silence reigns in the ship, with each gun's crew lying down round its gun. The effect of a broadside thus delivered, if well directed, is immensely in excess of the same number of guns hitting in succession. If the ship is being fired at at the time, this firing possesses the advantage that only one man is necessary to fire the broadside; this would be an officer selected for his coolness under fire and his knowledge of the director, and even he would be in the strongest part of the ship and quite hidden from view and protected; all others would be lying down under cover. Another and most useful method of using this firing is to give the guns the necessary elevation and let the guns' crews keep the training on. The captain of the gun has only one thing to look out for, *i. e.*, his training; the officer at the director will look out for the elevation, and the motion of the ship will be made use of for elevating the guns; with central pivot mountings and cogged gear for training, the motion is so smooth and easy that there is no difficulty in keeping the training accurately on; but of course this manner of using the director is only possible when the object fired at is distinctively visible.

To return to our attack.

As we approach the 5-fathom line we must alter course, which we do under cover of smoke again, and bring our stern guns to bear. All the time we have been engaging these batteries, our Q. F. and machine guns have been keeping up a continuous fire on the embrasures, parapets, or any loop-hole which may have presented itself, the Q. F. guns throwing shell at the rate of five or six a minute, which would be comparatively slow; and with the accurate fire made by these guns it is considered that they would do very considerable execution. The squadron now retires, the two smaller vessels are recalled, and stock is taken of damage done. It is sometimes said that one good shot from a heavy

gun may disable a ship. Well, I am doubtful about that; but even supposing it to be the case, the chances are very much against this one particular good shot ever coming off; and taking the case of the Huascar and Almirante Cochrane, the latter hit the former some eighteen or twenty times at close range (200 yards sometimes), and yet after the action the Huascar was capable of steaming 200 miles into port.

• Well, we find that the two smaller vessels have suffered most and will take a little time to repair damages. Several guns have been disabled in the larger vessels, and one has a hole through her bunker. She is rather heeling over on one side, but otherwise still good for fighting. On the side of the defense, battery H is completely silenced; battery E has suffered severely, apparently, but still shows fight; her 6-inch guns on hydro-pneumatic mountings are still game to fight, but as they fire so slowly and make such bad shooting while we are on the move, we do not dread them very much; still we want to silence them and to give B battery a turn, so we return to the attack on much the same lines as before, only making our direct attack on B, and leaving the second-class cruisers to get ready for the work which must take place at night.

In this second attack we succeed in silencing E battery, and have two or three more of our guns disabled. B has been knocked about a good deal, but sufficient has been done to enable us to haul off and prepare for our direct attack on the harbour. The Admiral does not think it wise to land any men, since he is not sure when the defending squadron may appear on the scene.

I am aware that it has been stated that ships cannot make good practice when under weigh, and will prefer to run the risk of anchoring, but this argument has been based on the method adopted at the bombardment of Alexandria, which, unfortunately, is a bad precedent to draw conclusions from in some instances. The glare of the sun behind the forts, the half-hearted enthusiasm of the defenders, and the guns of the ships engaged not being of the most modern type, more particularly their mountings, when training and elevating was not the simple, smooth and accurate motion which it is now—all these reasons were taken into account, and the ships were anchored. So far the action has been an artillery duel between a certain number of ships and a certain number of guns mounted on batteries of various sorts. The number of guns of attack will always be in excess of the defense at the commencement of an action, for sufficient ships will be sent to ensure at least twice as many guns being brought to bear on the defenses as they can bring to bear upon the attack.

Let us, therefore, consider the *pros* and *cons* of such a duel.

To begin with: The attack, whatever its strength may be, will always have



by measurement on the chart : thus the ships know the range accurately, the guns are laid for elevation due to this range beforehand, and fired either electrically or by word of command. On the side of the defense the men using the range-finders are more or less exposed. The methods of firing at a rapidly moving target are seldom if ever practiced on account of interfering with shipping, etc., etc., and I would ask you to notice this small table :

Nature of gun. Inch.	Range. Yards.	Time of flight. Seconds.	Distance within which an object 20 feet high must be known to hit.	Time taken to come this distance at 15- knot speed, allow- ing 100 yards for length of ship.
			Yards.	Seconds.
9.2 B. L. R.	6000	12.00	19	14
"	2000	3.5	92	23
6 B. L. R.	4000	8.08	31	16
"	2000	3.5	92	23

From which it will be seen that range-finders will hardly be of much use, for there is not sufficient time to lay the gun and fire it after the range is ascertained, before it will be again necessary to alter the elevation. It will, therefore, appear that the only way to overcome this difficulty will be to lay the guns for some point over which the ship will pass, and fire as they come on, which, you will observe, is the same principle as that employed by the attack, with this difference, that the attacking ships are sure to pass over the point they steer for ; but are not so sure to pass over the point for which the defense guns are laid. On this point, therefore, I think the argument is in favour of the attack.

Now take the question of training and sighting. All new naval gun-mountings admit of being able to fire the gun while in the act of elevating or training, or even adjusting the sights. I am not sure on this point, but I don't think land mountings admit of this. Take the case of guns mounted on hydro-pneumatic disappearing carriages—what sights are used? Scott's sights have to be shipped, the gun laid, and the sights unshipped again before the gun is fired. Surely these will be no use against a rapidly moving target. Reflecting sights have never, I believe, been tried against a rapidly moving target, and ordinary target sights generally smash up by jar of the recoil ; but if used, the men sighting the guns have to be exposed, and with the rapid and accurate firing of the Q. F. and machine guns, I don't think that a very steady aim would be taken. On board ship the men are not exposed, and can see along their sights, a much more simple and, I believe, more suitable method for fighting purposes than trusting to reflection or delicate instruments which won't stand the shock of the recoil.

The next point is : Can the guns of the defense be concentrated on any individual ship at the will of the officer in command? On board each ship this power of concentration can be and is done, as I have already explained, by director firing, electrically, and otherwise ; but in many cases this ability to concentrate the fire would be far more applicable in firing at ships than in ships at batteries, because in a ship, so many guns and vitals are centralized in such a small place, whilst in a well-defended harbour the batteries are much dispersed, and, in fact, single guns dotted about here and there in good positions would be less liable to destruction than guns mounted in more imposing batteries ; but whether the guns are in batteries or single, they should be capable of concentration. To do this, means that the organization must be exceptionally good, and communication perfect. I am assuming that every gun is in free communication, either by telephone or telegraph, with the position from which the defense is being conducted, for semaphore or flag signaling, or lights at night, will be quite out of the question, as the smoke would obscure it, and machine-gun fire would be too hot for the signallers. You will

remember that I explained that all communications on board ship are protected by an 8-inch armoured cylinder above water, and are behind the armour below water. Are the communications on shore protected, or are wires suspended from posts used? If so, these will be almost certain to come to grief, and the communication will therefore break down, and control will cease. If they do break down, the attack will gain another advantage. The last point to consider in this duel is the visibility of the object aimed at, and here I will admit that the defenders have decided advantage, at any rate at the commencement of the action, for they can conceal their batteries to a great extent, while a ship cannot be concealed in the daytime. As the action progresses, the batteries will gradually become more visible as the foliage or earthworks get knocked away. Taking all these matters into consideration, I do not think that the attacking fleet will suffer much so long as they have room to move about, and not at all during their direct advance; and when they come to close quarters, their superiority in number of guns, especially the Q. F. and light guns, will tell enormously in their favor, and leave no doubt in my mind as to the ultimate success of the attack in silencing the batteries facing the open sea.

Having sufficiently silenced the outer defenses, the fleet will now anchor in some sheltered spot, if possible, to make their preparations for the attack on the mine-field, which, it is supposed, exists; at any rate it would be rash to go nearer the shore without having carefully examined the ground. The first thing to be done when the ships anchor will be to put the slip on their cables ready for getting away at a moment's notice in case of necessity; then hoist their boats out and prepare their torpedo-net defense. If they have had the opportunity before arriving off the port, they will have seized some steamer and put a crew on board and have anchored her well outside the sphere of action; the boats belonging to this steamer will now come in useful to make up for the boats which have been damaged in action. Gun-cotton charges for blowing up a boom, explosives, sweeps, creeps, and countermines, sheers over the bows of the steamboats for clearing obstructions, fittings to enable the boats to jump a boom, and all the various necessities for a torpedo attack, have got to be put in the boats, the two longest operations being preparing the countermine, launching and rigging the net defense. All the time these preparations are going on will be a most anxious time, as it will be the opportunity for torpedo or gunboats, if they exist, to worry, if not actually to attack the enemy, and force him to keep a portion of his men at their quarters and prevent him, as much as possible, from getting his torpedo nets into position before darkness



search-light to blind the eyes of the gunners in the batteries. These lights he will not keep fixed, but will direct their rays first on, then off, the batteries, which is most confusing. The light for guarding against torpedo-boats will be worked round slowly, and then back again. It would be better to keep fixed rays, provided there were sufficient lights, but as there are not, each light must be worked through an arc of 90 degrees. The ship which is told off to make the first advance through the cleared channel will remain under weigh, and will do one of two things—either put out all lights in the ship and keep up a continuous fire of shell or blank cartridge (the object being to make much smoke and so to prevent the defense from seeing what is going on), or he will throw his search light in the eyes of the defense, taking care not to allow the rays to fall on his own boats which are advancing: the direction of the wind will decide which is the wisest course to take. The boats will be sent away immediately after dark.

Guard-boats, armed with Q. F. guns, whose duties it will be to keep about, above 1500 yards or 2000 from the ship, and not to come closer; to look out for and attack guard-boats of the defense; to give warning by signal if a torpedo-boat is seen passing them; and to protect the countermining boats when they commence operations. They must on no account follow up a torpedo-boat which is attacking, because the ships must have full liberty to fire on all boats approaching them.

Creeping-boats, armed with a machine gun and explosive creeps, fitted with what is called jumping gear, an inclined plane over the bows, to enable the boats to jump a boom. It is astonishing what a boat will jump when so fitted; a boom consisting of four baulks of timber, each one foot square and lashed together, has been jumped in this way, and even more astonishing results than this have been obtained; but I regret I have not the details by me. The boats will also be provided with small sheers over the bows, with a creep suspended from them, and hanging a foot or two below the surface of the water, to catch nets or entanglements which may be laid down with a view to fouling the propellers of steamboats. Their duties will be to creep for and blow up electric cables to which the mines are connected; some will be told off to work in the channel to be cleared, and others to go close in shore in the most likely direction for grappling the 4-core or other multiple cables. One such cable being cut may disable about 26 mines.

Boats for sweeping. These boats work in pairs, with a sweep or weighted rope between them. Their object will be to sweep for mines floating below the surface, and when grappled, a gun-cotton is hauled underneath it and exploded, thus destroying the mine. Each pair of boats, following the leading boats, will work in behind one another, so that no portion of the channel to be cleared is left out; they will drop small buoys on their outer flanks, to show what portion has been cleared.

I should have explained that in selecting a channel to be cleared the Admiral will carefully consider in what direction it is best to proceed, taking into account the depth of water, the tides, the distance from the possible position of a test-room, and so on. He will mark off a straight channel as being the shortest, and will not clear more than about 120 yards in width. He will arrange position lights of some kind as guides to the boats advancing, to see that they are keeping the channel laid down for clearance. The steamer, which, you remember, had been taken prisoner, will be brought up, and as few hands as possible, probably volunteers for the work, put into her, with directions to steam through the channel, with the object of enticing the enemy to explode his observation mines, over which she will pass, or to bump any mines to be exploded by contact;—she will have had a certain amount of water admitted into her to bring her down to the draught of the largest ship to go through the channel. The officer in command will have directions to put his helm hard over directly a mine explodes beneath him, so that should he sink, he will not block the channel. He will be provided with boats to enable the

crew to escape. Boats with special charges will be sent on to make a breach in the boom, should one exist; and finally the countermine boats will advance. Time will not admit of my entering into all the numerous details of the fitting of these boats: suffice it to say that their object is to lay large mines (500 pounds), and explode them in the channel to be cleared, at such distances apart that no mines within range of 90 feet from each countermine will be effective after the explosion. The countermine may therefore be laid 180 feet apart, and if two parallel lines are laid with that distance between them, the channel cleared will be 260 feet wide.

Countermining is the most rapid and certain way of clearing a channel; but it requires a large amount of material in proportion to the space cleared. A line, or two parallel lines, will clear a channel 760 yards long in less than five minutes. A service launch carries one line of twelve mines, with sinkers and buoys for marking the channel. The mines are arranged to drop automatically; and the boats towing countermine boat carry the firing batteries for one end, and the advance ship will fire from the other end, all the buoys marking the channel. The next pair of boats then run their mines, and ship advances as before. The ship will keep up a heavy fire during the running of the countermine, in order to cover them as much as possible by smoke. As one ship advances, so another will follow in her wake, and thus the attack will go on until the channel is cleared or daylight appears, when the boats will be recalled, and the ships must trust to their guns until night falls again, or they must retire, as it would be particularly awkward to be caught by the defending fleet in such a predicament. This is where the advantage of having a deep defense comes in. I do not think it will often be possible to continue the attack on a mine-field in daylight unless there are no guns or no gunners left to man them, for the fire of light guns would be too overpowering for boats to work, even though they were covered by a brisk fire from the ships. To retire must mean that most of the work must be done over again, for the defenders would certainly take the opportunity of removing all the buoys placed by the attack and laying down more mines instead, so that perhaps the wisest course would be to retire to the entrance of the mine-field when he can get away quickly, if need be, and where he can keep guard over that portion of the field which he has already cleared. And here we will leave him, as I have trespassed far too much on your time already, and have said quite enough, I hope, to give a general outline of an attack on a protected harbour, and to raise a few points for discussion. But before I sit down, I have a few words to say which will not detain you many minutes. I do not think that in any line of fighting is practice so essential as in that of attack and defense of harbours, for without practice, organization is impossible. The grievous errors that have been made both by the attack and defense in all the experiments which have been made at Milford Haven, Hayling Island, and so on, must be seen to be realized; they are only brought out by practice, and can only be remedied by organization: all this can be done in peace time. It is no use having the material unless we know how to use it to its best advantage. Submarine mines are no use unless they can be laid out quickly and maintained efficiently. It is easy to say we will put a boom across here and boat mines out there; but has it ever been tried out there? Where it has been tried it has been found that the difficulties are very great.

Are there definite orders as to how and where guard-boats and torpedo-boats of the defense are to withdraw, and due precautions to prevent firing upon friends?

Do the search-lights playing on the mine-fields interfere with the gunners working the guns in the battery, and can the light be directed from some position away from the light, as it is well known that those working the lights cannot see where to direct them?

Has the officer in charge of the firing of observation mines ever practiced his duties at night with the atmosphere charged with smoke?

Has the officer in charge of firing batteries definite orders?

Is it clearly laid down where military duties end and naval begin?

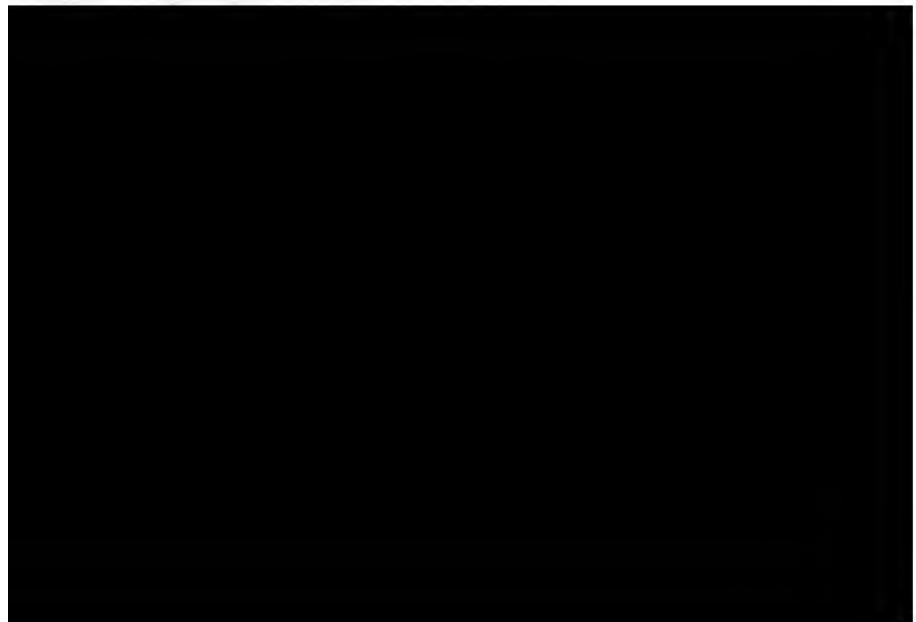
Can guard-boats be provided immediately, and are the guns ready to go in them, and do the crews know their duties?

These are a few of the practical questions which have to be settled by trial and observation, and I am sure that Col. De Wolski will agree with me, after our Milford Haven experiences, that unless these attacks are practiced in time of peace at night, and under cover of smoke, the mistakes which will certainly be made when the real test comes cannot be overestimated.

Sydney is defended by guns and submarine mines; there is the naval element here for its defense, and there is a squadron on the station for attack; there are all the necessities at hand for attack and defense, and I am sure that if the two meet in friendly contest, more practical experience would be gained by all concerned in one night than by years of theoretical study.

[From the *Electrical Engineer*, October 1, 1890.]

The introduction of the electric light on board ships, and especially on war vessels, with a full equipment of generators, has naturally afforded an opportunity for the introduction of other electrical devices, notable among which are electric motors for ventilation, for the training of guns, for the hoisting of shot, etc. But a new departure has recently been taken in the application of electricity to warlike purposes, in the introduction of range-finders depending upon a few simple principles, among which that of the Wheatstone bridge is prominent. The public is already familiar with some forms of Lieutenant Fiske's range-finders, which he has recently, however, simplified to a considerable extent, so much so that the readings can now be taken direct from a graduated dial. The description in this issue of Lieutenant Fiske's new range-finder shows it to be a neat application of the modified Wheatstone bridge principle; and not the least notable point in connection with it is, that the errors due to the variations of the conditions from actual theory are compensated for by the very construction of the apparatus. With all these refinements and means placed at the service of the commander of a modern war vessel, it is indeed problematical whether the carrying on of warfare would be a pleasant undertaking in the future, considering the enhanced probability of a shot taking effect. The fact may also be noted here that the U. S. S. *Baltimore* is probably the first naval vessel in which a telephone service has been established, so as to enable the commander to communicate from the conning tower with the various parts of the ship.



REVIEWS.

SUBMARINE MINES IN RELATION TO WAR. By Major G. S. Clarke, C. M. G., R. E. Woolwich: Printed at the Royal Artillery Institution, 1890.

Major Clarke in his concluding paragraph says: "... It had been sought to raise discussion upon the various points connected with the war uses of submarine mines, merely because such discussion is at present entirely wanting. All the other elements of defense, all questions of tactics by sea and land, have been subjected to searching and critical enquiry in endless books, pamphlets, and lectures. Nothing but good results from free discussion, by which alone can vagueness of thought and hallucination be swept away. The same method—the ordinary method of all science—must be applied to submarine mines, in order that they may be enabled to take their proper place in the Imperial Armoury. If an authoritative basis can be arrived at, they will fall at once into their legitimate sphere." He adds that his opinions are those of a "non-expert." Lawyers are held to be unfit jurymen, probably because their training is that of partisans, and in the consideration of legal technicalities they are apt to lose sight of the equity of the case. For the same reason it is well to have the opinion of a "non-expert" on the use of submarine mines, free from the bias begotten in the evolution of the mine-field.

Quoting from the Chatham Text-Book of 1873, Major Clarke says submarine mining defense is stated to be suitable for: (a) First-class fortresses, such as Portsmouth; (b) Mercantile harbors, such as Liverpool; (c) Undefended harbors, such as Belfast; (d) Small harbors, such as Whitby; (e) Open towns, such as Brighton; (f) Open beaches, such as Sandown.

The defense of open towns and open beaches against a fleet armed with long-range guns hardly needs serious consideration. To sow the sea with mines for the very ordinary radius, for bombardment, of 6000 yards, would be a serious task. As for an undefended harbor, that is, undefended by ships or guns, whether or not the mine-field is destroyed is simply a question of the disposition of the enemy.

In considering the case of defended harbors, the first question is as to the form of the port. If it is in the nature of a *cul-de-sac*, such as Plymouth, the inner harbor being commanded by guns, would any naval commander enter? Could even a battle-ship occupy herself in bombarding the town from such a position with her limited supply of ammunition, while batteries with a practically unlimited allowance were pounding away at her? It certainly is not likely that a naval commander would run into such a trap, even if cordially invited, and therefore mines would serve no purpose.

When the harbor is of such a shape that a fleet, once past the defenses of a narrow channel, finds itself in wide and safe waters, uncommanded by guns, and free to continue its operations, the use of mines is obvious, since every effort must be made to stop the passage of the enemy into the inner waters.

The time required for the construction and emplacement of modern heavy guns is so considerable that little can be done for the protection of a port, by guns, on the outbreak of war, unless they are already in position; and in such a case it may be protected from the entrance of an enemy's fleet by mines for perhaps a few days, giving time for the arrival of a protecting fleet. The

guns, once in position, are always ready for instant use. The laying of a mine-field takes considerable time and can never be commenced until war is at hand. Major Clarke considers it a valuable accessory in certain cases, but he protests against the absurdity of the pretension of the Chatham text-book and against the overgrown mine-field, with special batteries to cover it, a special flotilla to patrol it and special search-lights to illuminate it, the latter probably interfering seriously with the work of the main batteries in case of a night attack.

It is to be considered, moreover, that a really efficient mine protection involves the destruction of the commerce of the port. Merchant vessels will risk running a blockade, but will hesitate to attempt the narrow channel of a mine-field, if one is left, at night.

It is well for us in this country to bear the lesson in mind. We cannot allow the commerce of our ports to be destroyed; and for defense we must have heavy guns, commanding not only the entrance, but the harbor itself, where possible, a fleet of battle-ships to prevent a blockade, and clear channels for the entrance of friendly vessels.

C. S. SPERRY,

Lieut.-Comdr. U. S. Navy.

ARCHITECTURE NAVALE.—THÉORIE DU NAVIRE. Par J. Pollard et A. Dubeout, Ingénieurs de la Marine, Professeurs à l'École du Génie Maritime. Vol. I.

This work on Theoretical Naval Architecture, as contrasted with Shipbuilding, is by two of the lecturers at "L'École d'Application du Génie Maritime," where the government students selected for the French Construction Corps take a course of two years.

Only the first volume has been received as yet; the remaining three are, however, in press.

The subjects to be treated in the complete work are: Calculations of the geometrical elements and properties of ships' forms, statical and dynamical stability, the rolling of ships in smooth and rough water, resistance and propulsion, the steering of ships, and the vibration of screw steamers.

Volume I. deals only with calculations of geometrical elements and properties, including methods and forms used in determining statical stability at given angles of inclination. Pp. 1-71 treat of methods used in calculation. The Trapezoidal and Simpson's Rules are explained, and their absolute and relative accuracy discussed. Woolley's Rule, the Method of Differences, graphic differentiation and integration, and mechanical integration are also

The chief original matter in the present volume consists of comparisons between the various methods explained. These are well drawn, and the distinctive advantages and disadvantages of each method are clearly and impartially pointed out.

A valuable feature of the present volume is a "Notice Historique et Bibliographique," being a list of 468 books and papers—chiefly English and French—upon the various subjects covered by the present work. The books and papers are classified according to dates and subjects, with short historical and critical notes upon the books.

D. W. TAYLOR,

Assistant Naval Constructor, U. S. N.

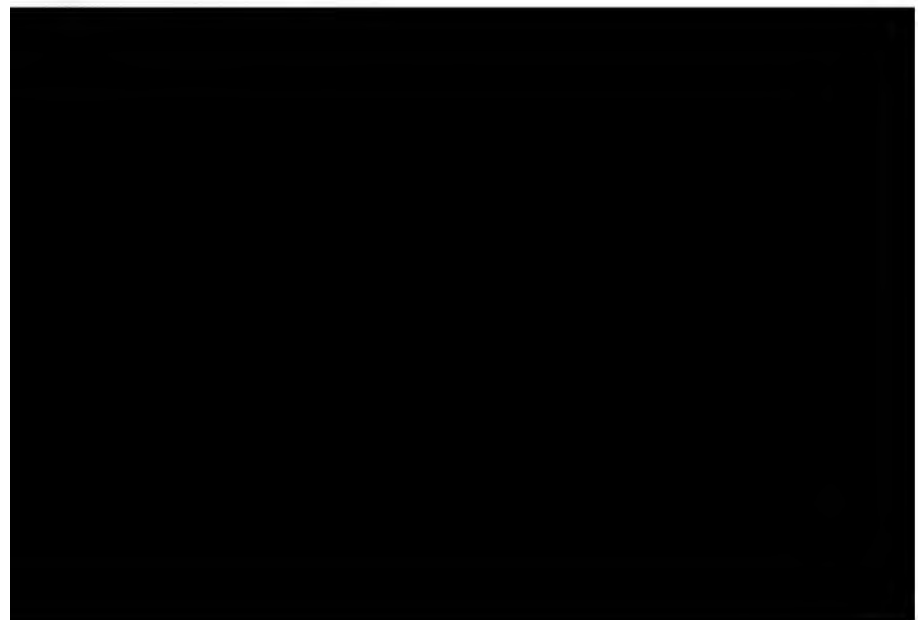
HAND-BOOK OF PROBLEMS IN EXTERIOR BALLISTICS. PART I.—DIRECT FIRE.

By Captain James M. Ingalls, 1st Artillery. Artillery School Press, 1890.

Captain Ingalls says in his introduction: "It is proposed to give practical solutions of all those problems of Exterior Ballistics which are likely to be useful to the artillerist, with examples fully worked out in the manner which a considerable experience has shown to be the most simple and concise."

The intention has been well and fully carried out, and the book is an excellent guide for practical work. The formulas used are those of Siacci. Certain auxiliary formulas for the convenient approximate solution of certain cases have been added, and the subject of Probability is treated. The book includes Ballistic and convenient Auxiliary tables.

C. S. S.



BIBLIOGRAPHIC NOTES.

AMERICAN CHEMICAL JOURNAL.

VOLUME XII, No. 4, APRIL, 1890. W. M. Burton and L. D. Vorce have determined the atomic weight of magnesium, finding the number 24.287 ($O = 16$). H. W. Hillyer describes a convenient form of gas generator for laboratory purposes. Reviews and Reports: Recent progress in industrial chemistry. Notes: Chemical examination of baking powders. Density, color, and spectrum of fluorine.

VOLUME XII, No. 6, JUNE. Gibbs and Hare continue the study of the action of definitely related compounds on animals.

VOLUME XII, No. 7, JULY. W. A. Noyes concludes his determination of the atomic weight of oxygen, finding the number 15.896. Reviews and Reports: Electrolytic dissociation. C. R. S.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

MAY, 1890. Notes on modern boiler-shop practice. Notes on the effect of temperature on certain properties of various metals and alloys. Tubulous boilers.

In this article, contributed by Assistant-Engineer Leonard, U. S. N., the principal requisites of a successful tubulous boiler are first given, followed by a general description with illustrations of each of the following types: Herreshoff, Belleville, Ward, Towne, and Thorneycroft. From the data of evaporative tests made at different times by boards of U. S. naval engineers, a table is added to compare the relative weight and space occupied by the three types of boilers—tubulous, locomotive, and Scotch. The following approximation is made from the table, on the assumption that the evaporation varies directly as the combustion, 25 pounds of coal per square foot of grate being used as a unit. The locomotive boiler should receive a favorable correction of about 20 per cent in columns 2, 3, and 5, on account of high rate of combustion. On the other hand, the Belleville boiler should receive an adverse correction of about 10 per cent, on account of low combustion. All the other tubulous boilers given, greatly exceed the Scotch in these advantages of weight and space.

Type.	1 Combustion.	2 Evaporation per cub. foot of space.	3 Weight per H. P.	4 Wgt. per sq. foot heating surface.	5 Wgt. per lb. of water evaporated.
Belleville,	.5	.5	2.02	2.1	2.5
Herreshoff,	1.	.95	.72	.6	.9
Towne,	1.	1.2	1.12	.87	1.3
Scotch,	1.	.44	2.4	1.64	2.3
Locomotive,	3.9	.31	3.7	1.25	3.5
Ward,	2.2	.58	1.27	.5	1.53

The machinery of the torpedo-boat Cushing. The White steam "turn-about" life-launch.

AUGUST. An account of the experiments made on the double-screw steel ferryboat Bergen. The manufacture and inspection of iron and steel boiler tubes.

In this paper is given a general description of the process of manufacturing lap-welded boiler tubes of the kind used in the service.

On the designing of continuous-current dynamo machines.

A reprint of an article by Mr. Andrew Jamieson, read before the Institute of Engineers and Shipbuilders in Scotland.

Speed trials of fast ships. Report upon trials of three steamers—Fusiyama, Colchester, and Tartar. Tubulous boilers, (a continuation of the discussion of this paper in the preceding volume, by Mr. Miers Coryell). Instructions for determining the coal consumption on vessels of the French navy.

J. K. B.

JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES.

MAY, 1890. The requirements of specifications for steel and iron.

A paper read before the Civil Engineers' Club of Cleveland, by Mr. Ritchie, in which are considered some of the most important points to be looked after in the inspection of steel.

JUNE. Recent progress of the metric system.

AUGUST. Ferroid, a new artificial stone. Compound locomotives.

J. K. B.

THE ENGINEER.

JUNE 7, 1890. The Justin dynamite shell. Economy of high expansion.

JUNE 21. Robertson's separator for steam boilers. The adaptation of steam machinery. Petroleum in steam boilers.

A paper on the results of using oil in the boilers of the steam-heating plant, at the Lansing Agricultural College. Previous to its use the boilers were badly incrustated with a hard scale. The kerosene seemed to work between the scale and the boiler-plate in such a manner as to loosen large flakes. Quantities of it are also found at the bottom of the boiler, in the shape of fine mud, which is readily removed through the blow-off pipe. At the present writing the boilers contain less scale than at any previous time during the past four years, and the small amount present seems soft and gradually disappearing. No injurious effect on the iron was perceptible.

JULY 5. The Forbin (a description of one of the recent additions to the French navy). The new navy.

JULY 19. The engines of the Mariposa. Coloring of metals by oxidation. Directions for working aluminum. Compound locomotives.

AUGUST 2. Notes on the use of hydraulic cements. Machine design for steel works. American locomotive boilers.

AUGUST 16. Rate of combustion in locomotives. Electric motors compared to locomotives. The progress of electric traction. Heat-energy.

SEPTEMBER 13. Electric launches. Case-hardening. The trial of the San Francisco.

SEPTEMBER 27. A broken crank-shaft. The education of engineers. Dangers of electric lights on English steamers. Ocean racing. Link motion *vs.* automatic cut-off efficiency. J. K. B.

INSTITUTION OF MECHANICAL ENGINEERS.

OCTOBER, 1889. On the results of blast furnace practice with lime, instead of limestone, as a flux. First report of the Research Committee, on the value of the steam jacket. Further experiments on condensation and re-evaporation of steam in a jacketed cylinder.

J. K. B.

MECHANICS.

MAY, 1890. The indicator, and its errors. The strength of fly-wheels. Notes on the action of lubricants.

JUNE. A special report of the Twenty-first Semi-Annual Convention of the American Society of Mechanical Engineers.

In addition to a report on the business transacted before the Society, reprints are made of the following papers read before the meeting: Standard method of conducting duty trials of pumping engines. An automatic absorption dynamometer. Steam engine governors. A use for inertia in shaft governors. A universal steam calorimeter. Engine tests. The measurement of the durability of lubricants.

AUGUST. A scientific boiler test.

An elaborate report of a test made by Mr. Michael Longridge, of a Babcock & Wilcox boiler, in connection with a Lowcock economizer. J. K. B.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.

AUGUST, 1890. Report of the French commission, on the use of explosives in the presence of fire-damp in mines. J. K. B.

PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS.

VOLUME CI. On the action of quicksands. The Calliope graving dock, Auckland, N. Z. On the probable errors of surveying by vertical angles. Wire rope. The deflection of spiral springs. Notes on a new method of distributing triangulation errors.

J. K. B.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

APRIL, 1890. Siacci's method of solving trajectories and problems in ballistics, Part III, by A. G. Greenhill, M. A., F. R. S., and Mr. A. G. Hadcock, late R. A. Sound velocity applied to range finding, (communicated by Captain G. G. Aston, R. M. A.).

MAY. Fire control in fortresses, by Captain F. G. Stone, R. A. Submarine mines in relation to war, by Major G. S. Clarke, C. M. G., R. E.

AUGUST. A range and training indicator, by Captain L. C. M. Blacker, R. A.

SEPTEMBER. Notes on the handling of artillery in the field, with especial regard to the supply of ammunition, by Lieutenant-Colonel N. L. Walford, R. A. Control of artillery fire in action, by Captain W. J. Honner, R. A.

JOURNAL OF THE MILITARY SERVICE INSTITUTION.

JANUARY, 1890. Danger from lack of preparation for war, by General Gibbon.

MARCH. Development of submarine mines and torpedoes, by Lieutenant James C. Bush, U. S. A.

MAY. Development of submarine mines and torpedoes (continued).

THE RAILROAD AND ENGINEERING JOURNAL.

JUNE, 1890. The Brooklyn dry dock. The latest Italian cruiser.

A general description and illustration of the latest addition to the Italian navy, named the *Fieramosca*, which is classed as a torpedo ram. On the trial trip the speed obtained was 18.6 knots, the engine developing 7500 horsepower. The main battery includes two 25 cm. guns, weighing 25 tons each, mounted in pivot, and six 15 cm. guns, mounted in broadside. There is a secondary battery of machine guns and six torpedo-tubes. Owing to the excellence of her armament, her speed, and the ease with which she was handled on trial, it is expected that this ship will be very formidable in action, more so, perhaps, than some of the very heavy battle-ships for which the Italians have shown a preference heretofore.

Preserving wooden piles. United States naval progress.



THE SCHOOL OF MINES QUARTERLY.

APRIL, 1890. Examination of mineral properties. Indian grass oils. Electrical engineering at Columbia College.

JULY. The wind problem in gunnery.

J. K. B.

REVUE DU CERCLE MILITAIRE.

APRIL 20, 1890. Notes on the equipment and subsistence of the soldier in the field.

APRIL 27. One year in Tunisia. The military institutions of China.

MAY 4. The French armament, as viewed from a Russian standpoint. Military institutions of China (ended). The war of Senegal.

MAY 11. The new Belgian rifle. Messenger pigeons and doves (giving interesting points in regard to training, feeding, and liberating, or starting off messenger pigeons, and the important part—every day more marked—that they may play in time of war).

MAY 18. The Russian officer in the army and in society.

JUNE 1. The Danish rifle, model of 1889. The envelope-tube of the barrel of the German rifle.

JUNE 8. Works of the geographical service for 1889.

JUNE 15. The field stadiometer.

JUNE 29. Note on a recording device of regulated firing; Demerliac system.

JULY 6. The discussion on the two years service in Germany. Mountain artillery. The Chinese navy.

JULY 13. Mobilization and manœuvres of the fleet in England.

JULY 20. The curvigraph, its civil and military use.

JULY 27. New firing regulations in Germany. The curvigraph, etc.

AUGUST 3-10. The Trans-saharian railway.

AUGUST 17. A glance at our naval manœuvres (French). The Trans-saharian railway (ended).

From present indications, it will not be many years before Lake Tchad and the Upper Niger will be in direct rapid communication with the shores of the Mediterranean. The completion of this great undertaking will, no doubt, add greatly to the influence of the French in Africa.

The new firing regulations in the German army.

AUGUST 24. The Victoria torpedo. The new firing regulations in the German army (continued). A glance at our naval manœuvres (ended).

AUGUST 31. The latest improvements in the European navies. A new type of revolver for officers.

SEPTEMBER 7. A curious mode of fabrication of metallic tubes. The new firing regulations in the German army (ended).

SEPTEMBER 14. The fortifications of the Saint-Gothard. The latest improvements in the European navies. J. L.

REVUE MARITIME ET COLONIALE.

APRIL, 1890. A study of the use of the sextant for observations of precision. Oceanography (statics), (continued). The history of a fleet of former times.

MAY. Trajectory of a projectile in case the resistance of air is proportional to the cube of velocity. The history of a fleet of former times (ended). Oceanography.

JUNE. Trajectory of a projectile in case the resistance of air is proportional to the cube of velocity. The English naval manoeuvres of 1889 (an analysis of an article in the Engineering of March 28, 1890). A statistics of wrecks and other mishaps at sea for the year 1888. A Note on Commander Fleuriat's "top" (a professional article). Exploration of the western Soudan.

JULY. Budget of the German navy for the year 1890-91. The navies of antiquity and the mediæval age. Studies of comparative naval architecture. Historical studies of the military marine of France (continued). Biographical notice on Rear-Admiral Le Blanc. Prizes awarded the authors of the best memoirs published in the "Revue."

AUGUST. The navies of antiquity and the mediæval age. Studies of comparative naval architecture. A method for the immediate adjustment of the standard compass in landfalls with, or without, interruption of the ship's course, by Capt. Fournier. Approximation with which a longitude is determined from an observation of the occultation of a star by the moon. Historical studies of the military marine of France (continued). J. L.

RIVISTA MARITTIMA.

Study on the compass deviations on Italian ships-of-war, by Capt. A. Aubry. Fire ships and infernal machines in naval warfare (historical), by Lieut. Ettore Bravetta.

RIVISTA DI ARTIGLIERIA E GENIO.

APRIL, 1890. Smokeless powder. Study on field redoubts, by Captain Spaccamela Pio. Miscellaneous: The Fiske range-finder; Rapid-firing guns, system Skoda; Experiments with the 10 cm. rapid-firing, the 75 mm. field gun, and the mountain guns, Canet system.
J. B. B.

REVISTA MILITAR DE CHILE.

JUNE, 1890. Trial of guns of the Krupp and the De Bange systems at Batuco, by Lt.-Col. J. C. Salvo. Tactics necessitated by the introduction of the small caliber long-range rifle (trans.), by Lt.-Col. Sofanor Parra. On the military position of Chile, by Col. José A. Varas. Instructions for target firing, by Col. E. de Canto.

AUGUST. A visit to the Krupp gun factories, by Col. Diego Dublé, A. Instructions for target firing (continued). On the military position of Chile (continued).

REVISTA TECNOLÓGICO INDUSTRIAL.

APRIL, 1890. Sanitary details of the city of Barcelona. The artificial harbor of Barcelona. Royal decree on electric installations.

JUNE. The dangers of the electric light. Theory of the steam engine.

BOLETIM DE CLUB NAVAL.

JANUARY, 1890. The question of armor-plated turrets. 7-inch guns, De Bange system. Historical points on the history of the Brazilian navy.

FEBRUARY. Hints on the study of naval tactics. The question of armor-plated turrets.

MARCH. The Brazilian Lloyds. Historical points on the history of the Brazilian navy.

APRIL. The armament of the Aquidaban. The cruiser Almirante Tamandaré. Hints on the study of naval tactics (continued).

TRANSACTIONS OF THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

JANUARY-MARCH, 1890. Notes on the dry-dock and coffer-dam at the navy-yard, Mare Island, by Otto V. Geldern (illustrated).

APRIL. Cofferdams and floating caissons, by Randall Hunt, C. E. (illustrated).

TRANSACTIONS OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

OCTOBER-DECEMBER, 1890. Cantilever bridges, by C. F. Findlay. The Colonial Government dry-dock, St. John's, Newfoundland, by H. C. Burchel. The Esquimault graving dock works, British Columbia, by W. Bennett.

JOURNAL OF THE FRANKLIN INSTITUTE.

DECEMBER, 1889. American isthmian canal routes, by Daniel Ammen, Rear-Admiral United States navy. Philosophy of the multi-cylinder, or compound, engine: its theory and its limitations; by Robert H. Thurston. On the dilatation and compressibility of water, and the displacement of its maximum density by pressure (translated from the French by B. F. Isherwood).

JANUARY, 1890. The electrical exhibits from the United States at the Paris Exposition. Philosophy of the multi-cylinder, or compound, engine (continued). A rapid method for phosphorus in iron and steel, modified from a method proposed by Dr. Thomas M. Drown; by G. L. Norris.

FEBRUARY. A test of an Otto gas engine. Philosophy of the multi-cylinder, or compound, engine (continued).

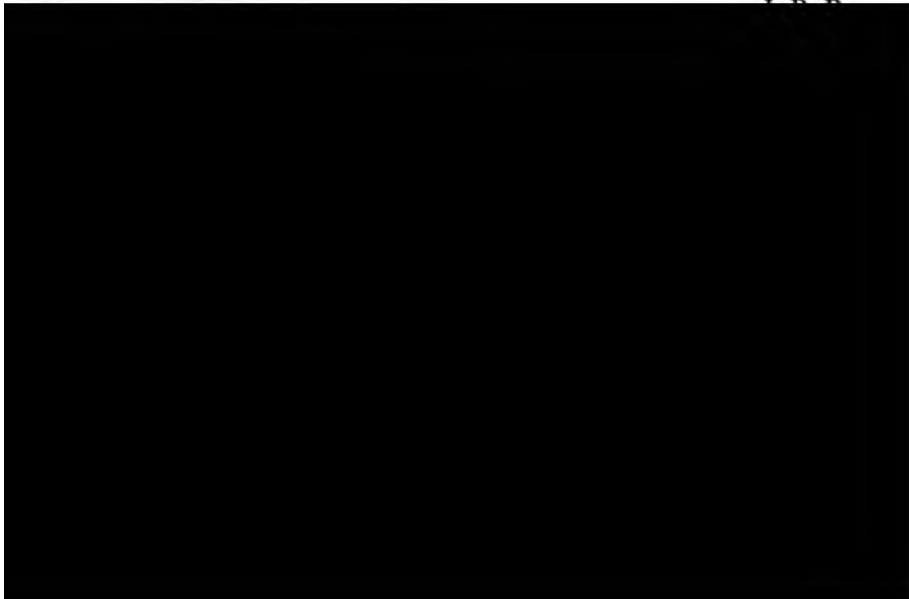
APRIL. Electric railways. The Hollerith electric tabulating system.

MAY. "Water ram" in pipes. Colt's new navy revolver, combined with a new cartridge pack for reloading.

JUNE. The purification of water by means of metallic iron. What does a steam horse-power cost? by Thos. Pray, Jr.

JULY. Report of the U. S. Naval Board on the Thomson system of electric welding. On the electro-deposition of platinum.

SEPTEMBER. Electricity in warfare, by Bradley A. Fiske.



ing the fire of anything more than machine guns, whereas the shield now devised effectually protects the gun and gunners from all rapid-fire guns at present in use in the service. At the trial which took place March 19, fifteen rounds were fired at angles ranging up to the maximum of 40 degrees, with perfect success in every respect.

The strength of ships.

A paper on the above subject, with special reference to distribution of shearing stress over transverse section, was read at the annual meeting of the Institution of Naval Architects, by Professor Jenkins.

The spontaneous ignition of coal cargoes. The effects of stress on steel.

JUNE. The screw propeller.

A paper read before the Institution of Civil Engineers by Mr. Sydney Barnaky, and dealing with the determination of the best dimensions to be given. The author submitted the results of recent experimental research, so far as they bore upon the solution of this problem. The experiments made by Mr. Thorneycroft with model screws were described, and the author's method of tabulating the results was explained.

On steamship propulsion. Marine engine governors. Various theories of the screw propeller.

In this article Mr. James Howden takes exception to almost all the leading ideas advanced on the subject by Professors Rankine, Cotterill, Greenhill, and Dr. Froude, the paper being directed expressly to the manner in which the screw acts on the water in propulsion, and the motions thereby imparted to the water in obtaining its propulsive effect.

JULY. On the dynamics involved in the lines and speeds of ships. Internal corrosion of vessels. The corrosion of iron and steel.

AUGUST. The L  g   torpedo. Launch of the cruisers Pallas and Phoebe. Formulas for model experiments. J. K. B.

THE STEVENS INDICATOR.

VOLUME VII, No. 2. Notes on the action of lubricants. Testing machines. Instruments for illustrating the action of the polar planimeter. Ericsson and his Monitor. Cost of lubricating car journals.

No. 3. The fabrication of twelve-inch mortars. Notes on the friction of engines. The identification of dry steam. The examination of lubricating oils. A new recording pressure gauge.

J. K. B.

TRANSACTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

JANUARY, 1890. The results of investigations relative to formulas for the flow of water in pipes.

FEBRUARY. Cast iron, strength tests, and specifications.

An article by Prof. J. B. Johnson, in which are given the results of some experiments at the Washington University Testing Laboratory, on the testing of cast iron for strength and resilience in tension, compression and cross

breaking; the methods and appliances there used; a new machine for cross breaking tests; an explanation of the high cross breaking modulus of cast iron, and, finally, a proposed set of specifications for engineers, to use for cast iron products.

APRIL. The railroad ferry steamer Solano.

JUNE. Calculations of the mean horse-power of a variable stream, and the cost of replacing the power lost, by a partial diversion of the flow. Observations on the Forth Bridge. J. K. B.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.

Aluminum and other metals compared. Notes on the energy and utilization of fuel, solid, liquid, and gaseous. The Heroult process of smelting aluminum alloys. Aluminum in wrought iron and steel castings. Preliminary note on the thermal properties of slags.

J. K. B.

UNITED SERVICE GAZETTE.

MAY 31, 1890. The Icarus court-martial. The Dover manœuvres. A year of lifeboat work. The Victoria torpedo. On a system of signalling between men-of-war and merchant vessels. America's naval policy.

JUNE 7. The summer manœuvres. The Dover manœuvres. The defense of Australia. Naval supremacy.

JUNE 14. The Royal United Service Institution. American warship design. The exigencies of modern warfare.

JUNE 21. Naval uniform. The Channel tunnel.

JUNE 28. Mobilization of the Royal Naval Reserve. Royal naval engineer officers.

JULY 5. Launch of war vessels. The Coast Guard. Spontaneous

were, at different periods, reported as suffering from defects of machinery, most of which were trivial, but some of a more serious nature. Considering the consequences likely to arise from a breakdown in case of actual hostilities, the Admiralty order is warmly welcomed, directing that high-speed trials shall be made once a quarter, each trial to be of not less than twenty-four hours' duration, whenever circumstances will permit, with the engines working at from one-half to two-thirds of their specified natural draft. During each trial the engines are to be run for a period of five hours at their highest speed with natural draft, but the horse-power developed is not to exceed the specified natural draft power."

The German naval and military manœuvres. The French naval manœuvres.

One effect of the French naval manœuvres this year has been to show up the smallness of the supply of fuel kept in the coal dépôts at Brest. These contained only enough for one coaling of the squadron, after which the supply was exhausted. A French naval critic points out, in the *Nouvelle Revue*, that the harbor of Brest, being the only solid base of operations for the Northern Squadron, ought evidently to be provided with coal enough to last six months.

The proposed naval exhibition.

SEPTEMBER 20. Attack on the Thames and Medway defenses. The defense of Australia. The navy. Letter from Admiral of the Fleet Thomas Symonds.

The writer opposes the present system of heavy armaments, advocating lighter guns and consequent higher freeboard. Reference is made to the recent manœuvres, where "half the heavy armament of two battle-ships, *Inflexible* and *Hero*, is disabled . . . and continued silent for many hours, and when soon afterwards a cracked steam-pipe, upon which the working of the hydraulic engines depends, obliged the armor-clad *Rodney* to return to port." "The serious error which is being made in continuing to overburthen our ships with guns that are, not only, too heavy to be efficiently worked by preventer gear (in case of the failure of the steam or hydraulic engines), but are likewise unreliable in several other respects for naval warfare, is only too manifest."

SEPTEMBER 27. The defense of Australia. The Royal Naval Exhibition. The Sardegna.

By the launch of the *Sardegna*, which took place at Spezia on Saturday last, another magnificent battle-ship has been added to the Italian navy. She is a sister ship to the *Rè Umberto*, built of steel, with 18 inches of compound armor on her barbettes; a length of 400 feet; breadth, 76 feet 9 inches; tonnage, 13,251; and she is expected to attain a speed of 19 knots. When fully equipped she will carry four 67-ton breech-loading Armstrong guns, eight 15-centimeter, and six 12-centimeter, and ten quick-firing and machine guns. Her cost will be one million sterling.

LE YACHT.

APRIL 12, 1890. Editorial: Remarks on Mr. White's address before the Association of Naval Architects. Notes from foreign ship-yards. Review of the merchant marine. Description of the French armored cruiser *Le Charner*, with plans.

APRIL 19. Editorial on reform in the French navy. Argument

in favor of squadrons of evolution. Review of the merchant marine. Torpedo-boats built in '89, with plans of torpedo-boat of the first class, built for Denmark by Thorneycroft.

APRIL 26. Description of the Magenta. Review of the merchant marine.

MAY 3. Editorial on the manœuvres of the French squadron escorting President Carnot; criticism on the ships and their personnel. Refrigerating rooms on board ship. Review of the merchant marine. Notes from foreign ship-yards.

MAY 10. Editorial on the work done by French arsenals. Review of the merchant marine.

MAY 17. Editorial criticising centralization in the French naval government. The torpedo-boats built in '89, with plans. Notes from foreign ship-yards.

MAY 24. Editorial comparing the Piemonte with the Forbin. Review of the merchant marine.

MAY 31. Editorial on the competition between guns and armor. Review of the merchant marine. Notes from foreign ship-yards.

JUNE 7. Notes from foreign ship-yards. Review of the merchant marine.

JUNE 14. Editorial on shore duty in the French navy. Notes from foreign ship-yards. Armor trials of the plates of the Chilian man-of-war Capitan Prat. Description and plans of the armored ship Tréhouart.

JUNE 21. Editorial on the separation of the Board of Admiralty from the Minister of Marine and Supreme Council. Review of the merchant marine. Plans of Yarrow torpedo-boats of first and second class.

JUNE 28. Notes from foreign ship-yards. Review of the merchant marine. Review of Captain Mahan's book, "Influence of Sea

AUGUST 9. Editorial on the German navy. Review of the merchant marine. The English second-class cruiser *Latona*, with cut. Armor tests of Schneider plates for the Danish government; four cuts showing impact of shot.

AUGUST 16. Accidents to the French fleet for the year. Resistance of steel.

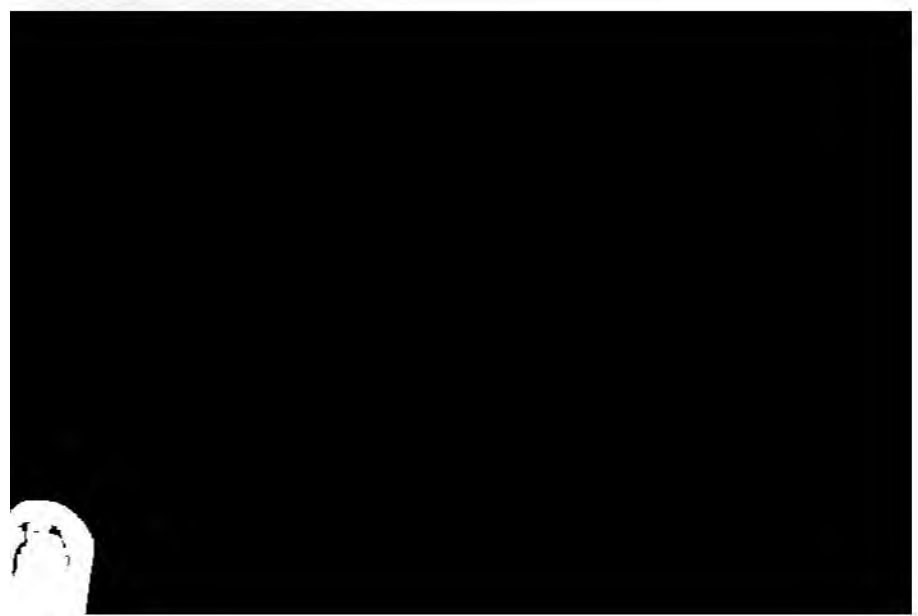
AUGUST 23. Editorial on English summer manœuvres.

SEPTEMBER 6. Editorial on naval manœuvres. Review of the merchant marine. A. C. B.

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3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.
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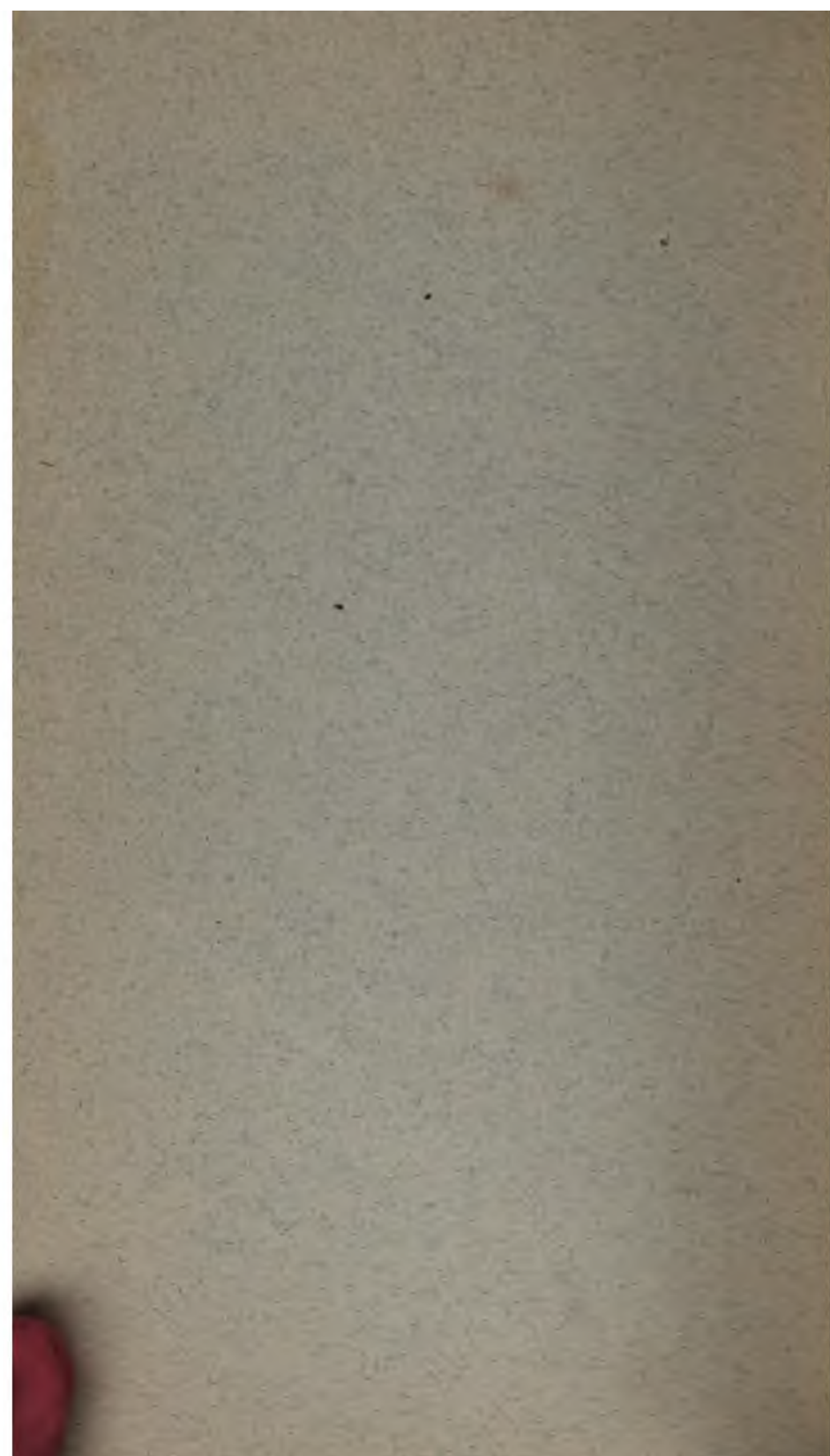
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PROCEEDINGS
OF THE
UNITED STATES
NAVAL INSTITUTE.

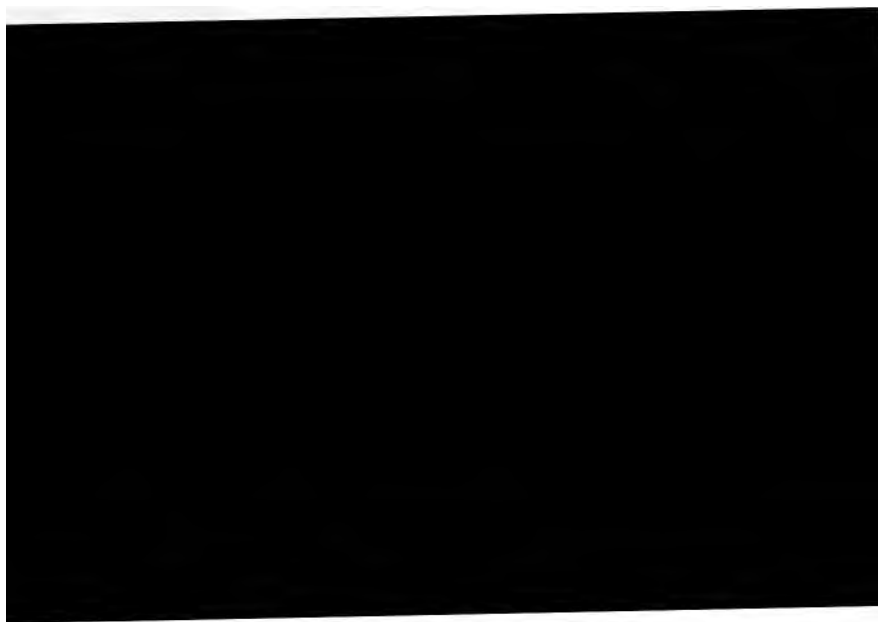
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THE PROCEEDINGS
OF THE
UNITED STATES NAVAL INSTITUTE.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, M. D.

INTRODUCTION.

THE ANNAPOLIS ARMOR TEST.

THE competitive test of armor plates made at Annapolis on September 18th and 22d last, was in many respects specially noteworthy. Not that anything positively new was made manifest, nor as our ultra-enthusiastic journals will have it, that the armored fleet of Great Britain has been proved disastrously vulnerable. The test has added a great deal to the amount of data previously existing, whose comparison and coördination are necessary for direction in the true line of armor development.

To the artillerist there are several points connected with this test that make it of the greatest interest. 1st. Because a new material for armor has sustained its first public and crucial trial. This point is of the greatest interest in view of the result obtained. 2d. Because in the test, guns, projectiles, and plates were most admirably matched, so that the test furnishes a very maximum of reliable information. It can readily be understood



that the choice of too high a caliber and projectile energy would have so completely pierced every plate at each shot that no margin would have been left for comparing effects, and, on the other hand, were the striking energy too light, so that all the plates had thoroughly resisted, no clear distinction could have been made. A wise measurement of the true power needed resulted in just taxing the plates sufficiently beyond their resisting powers to make a judgment simple and plain concerning them. 3d. Because not only was the test a public one in the amplest sense, but that the official report is clear and concise, and has been made public at the earliest moment. In this case it is not necessary to depend upon journalistic accounts, which, however well intentioned, almost invariably err in the omission of some really important detail, or in giving wrong data, or unintentionally giving a false coloring to results obtained. Nothing can be more distracting than to see a carefully written statement of a test where initial velocity is given and the distance of the plate from the gun is omitted, or where a gun caliber is given, and the weight and description of projectile are omitted; or where the minutest detail is given of the effects of a shot on the plate, whilst nothing is found regarding the effect of the plate on the projectile. The official report of this test is as remarkable for the completeness of its record as for its brevity. It contains exactly what is needed by the artillerist for study—nothing more and nothing less.

To those who have not made an intimate study of armor contests the comparative importance assigned to this test doubtless seems exaggerated. A thickness of plate of $10\frac{1}{2}$ inches is not much in comparison with the 16- and 19-inch plates that have been the prominent subjects of contest abroad; and the 6-inch gun is a weak weapon compared with the 15- and 17-inch monsters that have been swung against plates in Europe.

In truth, though, this test cannot be belittled because of the light plates and projectiles. The striking velocity of the shells was higher than that of the European armor tests. The power of the plates to resist was also greater. In addition to this, by having the plates of uniform thickness

THE ANNAPOLIS TEST

the already heavily punished gun. The velocity was far below that of the 4-inch. While the velocity was enormously greater, the power of the shot was not disintegrating, or showing any of the effects which was thoroughly tested. It is true that the armor compared with the heavy belt armor. But the importance of the test was not the fact that it led out directly leading to an answer. The test would feel prepared to accept the fact that of metal that, by proper treatment, was perfect armor plate, the manufacturing process developing these qualities was to be made plate becomes thicker. These plates were manufacturers in the world who were not but whose business interests were not then, these plates were not the best. It is inevitable that compound armor, on the hand, for the compound plate has been and just so far as difficulties in perfecting come, exactly to that degree does the material become manifest in the test.

It will not do to accept the results generally. Although the compound armor must be remembered that even the rivalry between steel and compound armor superiority has always been in the since, in a competitive test in badly in comparison with a compound in Annapolis. It is only by comparison

that any true idea of the compound armor are composed of quite out of the made against possible to perfect he secured the of the

It is necessary, first, to take into consideration the scale of measurements, as it were; for it is readily seen how endless arguments will occur unless there be some common standard of reference. For example, in England compound plates beat English steel, where a projectile having 1975 feet striking velocity was used. At Annapolis, with the same thickness of plates, same caliber of gun, but 2075 feet striking velocity, French steel plates beat compound. Now, it would be interesting to know whether the steel at Annapolis was better than the steel in England, and if so, whether it was better than the compound plate in England, and whether the English Cammell plate was better than the American Cammell plate. Then again, how is one to compare the results of 6-inch projectiles on 10-inch plates with those of 11-inch projectiles on 15-inch plates? There is a method, not at all abstruse, which will give a fairly true basis of comparison. It is only necessary to prelude the description with the warning that a knowledge of this method and of the results obtained does not make one an expert judge of armor, and that it requires an expert to properly weigh all the circumstances of any test. By the use of this method one could not well prescribe what should be the conditions of a test to be made, but since tests are prepared and carried out by experts, due regard has been had to the proper composition of the elements, so that results translated or compared by this true method will be nearly



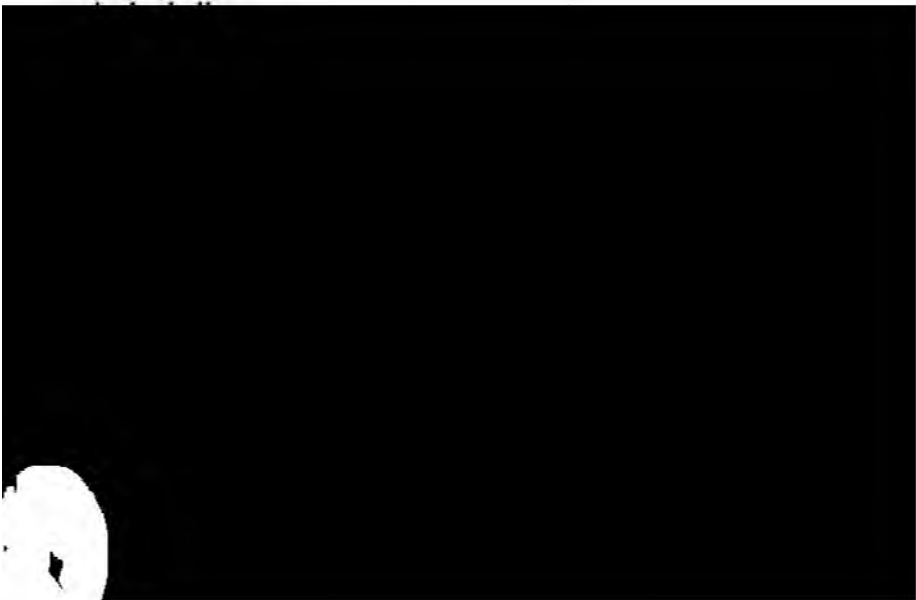
As compound and steel plates came in to replace iron ones, two great difficulties were met with in attempting to compare results obtained. The development in manufacture was slower and much more difficult, so that very great variations were met with in the resisting power of similar plates. So great, that it was found impossible to formulate the results in any way that would be even remotely satisfactory. The best that could be done in the way of conveying an intelligent idea was to adopt wrought iron as a standard of reference, which its regularity permitted, and to speak of a steel or compound plate as being equivalent to a certain greater thickness of wrought iron. It must be remembered that a mere expression of a certain number of foot-tons of energy conveys no intelligible idea, even to the expert, for it requires different energies to force shells of different calibers through a plate of a given thickness. It was more definite to say, for instance, of a 10-inch compound plate that it was equivalent to 12½ inches of wrought iron; for, at least, by this means one could get at some idea regardless of caliber of projectile.

The other difficulty was that the power of the plates was sufficient to smash or distort the best projectiles that could be brought against them. That a plate should be capable of smashing a projectile is creditable to the plate within certain limits; but we evidently cannot determine the comparative resistance of two plates if both break their projectiles, for we have no standard of measurement. There is an immense difference between making a projectile test the strength of a plate and making a plate test the strength of a projectile.

Projectiles gradually improved in strength until in the Holtzer shell they seem to be developed to a point where the most powerful armor cannot break or deform them, as a rule. This acquisition brings us at once within a fair and safe measuring distance of our standard, and we may in a single expression convey to the mind a definite idea, where not only can we omit the caliber of projectile, but also the thickness of plate itself, and thus we arrive at a direct comparison of armor systems. The method of arriving at this expression is as follows:

Assume a steel plate of 9 inches thickness, against which a Holtzer shell is fired with a certain energy, and assume that this shell barely pierces the plate. Take one of the many well-known formulas for penetration of wrought-iron plates (the Gavre formula recommends itself by its simplicity and flexibility), and compute the energy necessary barely to send *that same* projectile through a wrought-iron plate of the same thickness. Suppose it to be found that this energy is 1000 foot-tons.

Now compute the actual energy with which the projectile struck the plate and assume that this energy is 1070 foot-tons. Then 1070 divided by 1000 equals 1.07, and we translate the expression by saying that the steel plate is a seven per cent plate. That is, that it requires seven per cent more energy to pierce it than would be required for a wrought-iron plate of the same thickness. The beauty of this expression is that, no matter what be the caliber of projectile brought against the plate, it is always a seven per cent, as compared with the same projectile against wrought iron, and no matter what may be the thickness of plate, the per cent always holds against a corresponding thickness of wrought iron. So then, by this expression we may grade plates in resisting power, whether they be steel, compound, or nickel-steel; and we may directly classify the nineteen-inch plate attacked by the fifteen-inch shell with the nine-inch plate attacked by the six-



the course of armor development it seems certain that as any system of armor improves, racking effects, which at first are invariably predominant, are gradually overcome until in the end they disappear entirely, whilst the resistance to punching is maintained or increased. The Annapolis test brings these features out very prominently, for the nickel steel showed both punching and racking resistance; the steel plate showed punching resistance, but was racked; the compound plate failed in both features.

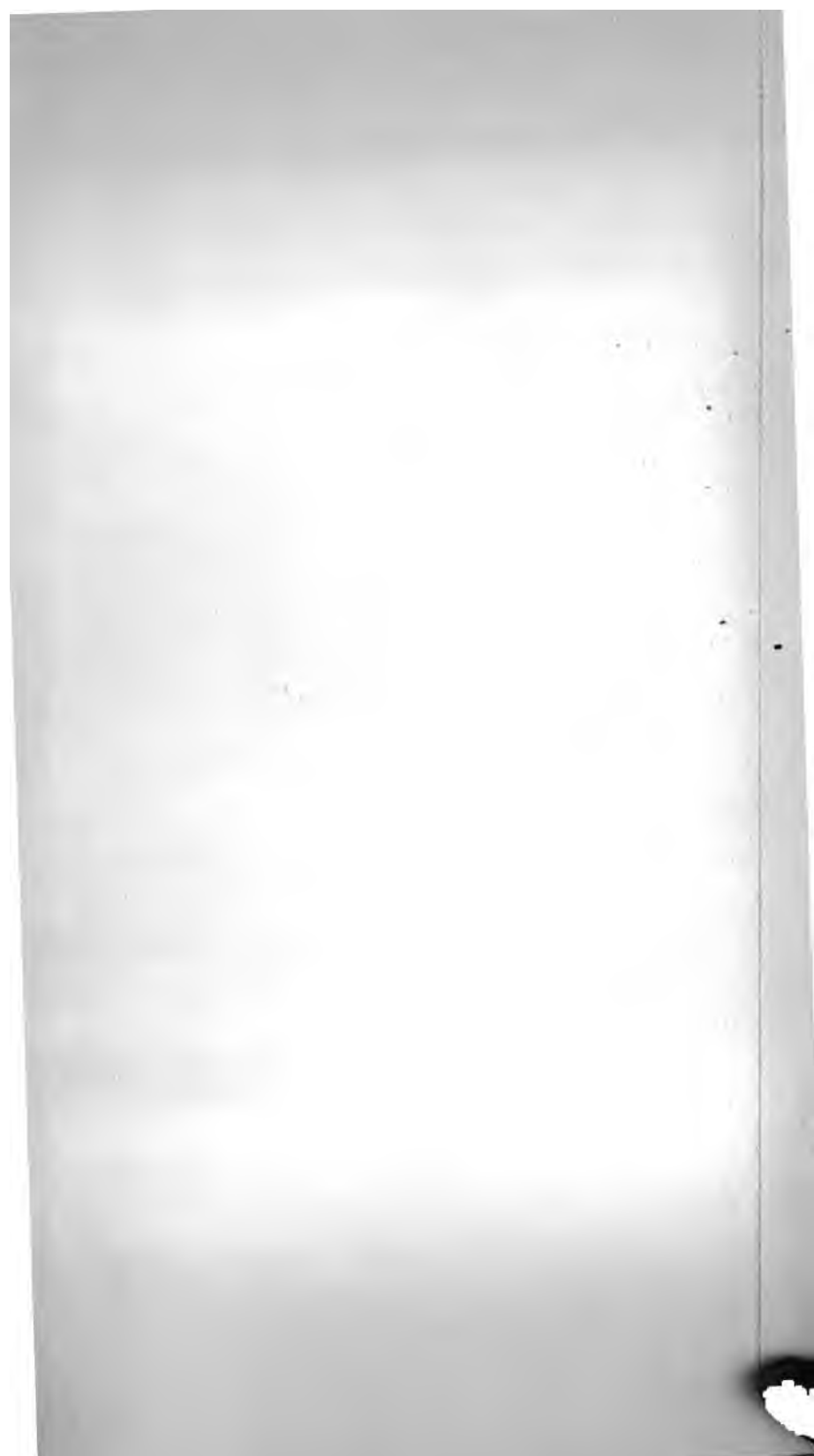
This method of classifying armor is here put forward for the first time. The method is by no means novel, but no utilization of the resulting expression seems to have heretofore been made, and it appears to be particularly well adapted to common use.

A few citations will bring out the character of the expression, and doubtless give a clearer idea of the strength of the plate exhibited at Annapolis.

In 1888 a lot of 6-inch Holtzer shells were delivered to the English Government under the stipulation that when fired against a 9-inch compound plate they should not break or be notably deformed. Under test they readily pierced the plate, and it is found by computation that the test was what might be called a twelve per cent one; or, as the plate was pierced with considerable to spare, it could not be classed as high as twelve per cent.

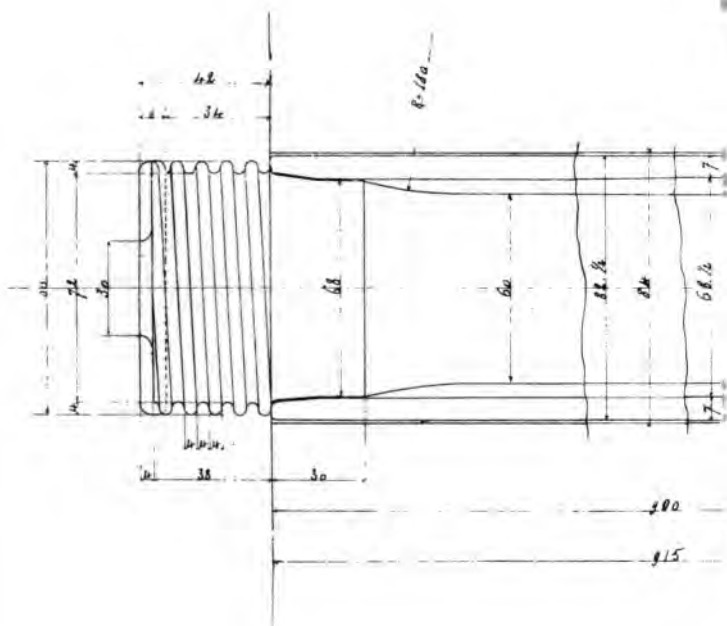
In the early part of 1888 an important test of armor plates took place at Portsmouth, England, at which the plates and 6-inch projectiles were exactly assimilated to those of the Annapolis test, the striking velocity being 100 feet less. This, by the method of classification, was a seven per cent test, and was well resisted by a Cammell compound plate, and a Vickers steel one. The test at Annapolis was an eighteen per cent one, and the Cammell plate broke down under it. Here, by this single expression a deal of light is thrown upon the action of the Cammell plates in England and here.

Not long ago, at St. Petersburg, an 11-inch projectile was fired against a 15 1/2-inch Cammell compound plate, the projectile barely getting its point through. The test was a five per

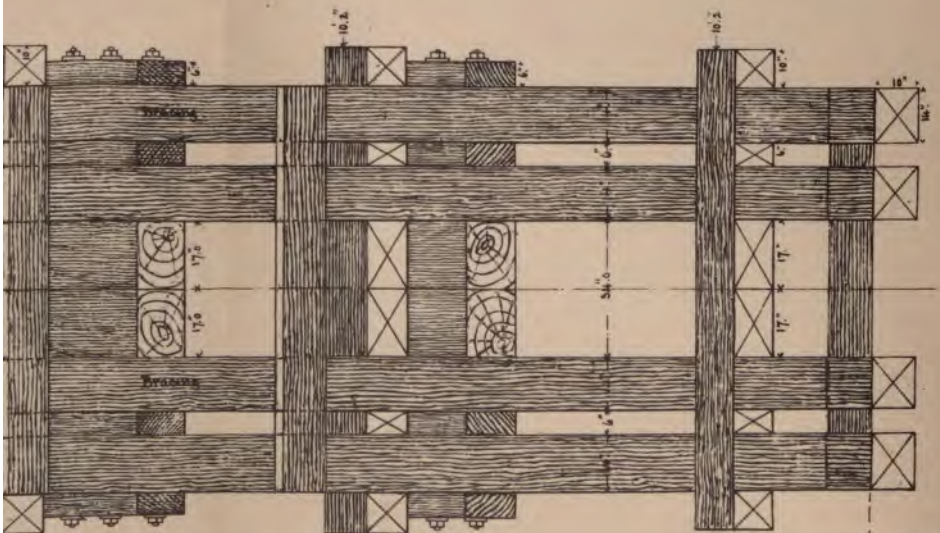
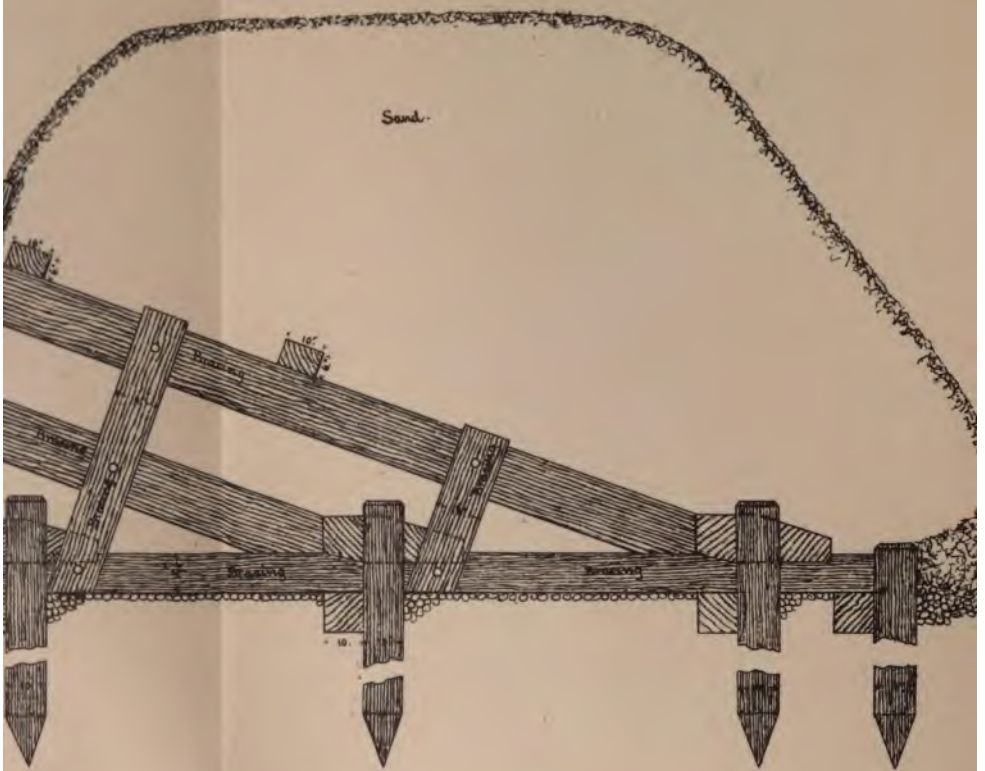




Lesson 16: 730/90







Length of Red Timber 33 ft.

1610

REPORT OF THE BOARD ON THE COMPETITIVE TRIAL OF ARMOR PLATES.

NAVAL ORDNANCE PROVING GROUND,
ANNAPOLIS, MD., OCTOBER 11, 1890.

In obedience to the Department's order of July 11, 1890, the Board met at the Naval Ordnance Proving Ground, September 18, 1890, for the purpose of conducting a competitive test of three armor plates, one of steel and one of nickel steel manufactured by Schneider & Co., Le Creusot, and one compound plate manufactured by Cammell & Co., Sheffield.

The Board made a careful preliminary inspection of the plates and their bolts and backing. They were all erected in accordance with a drawing furnished by the Bureau of Ordnance to the Inspector of Ordnance-in-Charge at the Proving Ground. The steel plate and nickel steel plate were secured to the backing with twelve bolts 2.36 inches in diameter. The compound plate was secured to its backing by eight bolts 3.19 inches in diameter.

Plate.	No. of bolts.	Diameter of bolts.	Total bolt cross-section.	Weight of plate.		Bolt section per ton of plate.
			Sq. inches.	Lbs.		Sq. inches
Steel	12	2.36''	52.29	20776 (actual).		5.66
Nickel steel	12	2.36	52.59	20679 (actual).		5.69
Compound	8	3.19	64.32	20992 (calculated).		6.86

The plans of the backing, the arrangement, shapes, and method of securing the armor bolts are shown in the photographs appended.

Caliper measurements were taken by Lieutenant-Commander Dayton along the edges of the plates before they were secured. A table of these is appended.

CALIPER MEASUREMENTS OF ARMOR PLATES.

Commencing at lower right-hand corner, up right edge, across top, and down left side, at intervals of one foot.

Point of measurement		Schneider all steel.	Schneider nickel steel.	Compound.
		Inches.	Inches.	Inches.
Lower right corner		10.56	10.22	10.65
Right side	1	.61	.45	.63
	2	.61	.65	.76
	3	.58	.65	.81
	4	.53	.64	.70
	5	.52	.49	.76
	6	.51	.45	.80
	7	.53	.38	.70
Upper right corner		.55	.24	.70
Top	1	.59	.38	.69
	2	.60	.41	.71
	3	.61	.41	.77
	4	.63	.41	.75
	5	.63	.38	.74
Upper left corner.		.55	.27	.67
	1	.56	.34	.70
	2	.51	.38	.59
	3	.55	.42	.67
	4	.53	.43	.71
	5	.58	.43	.67
	6	.63	.41	.69
	7	.63	.57	.76
Lower left corner.		.50	.37	.76
	1	...	...	.83
	2	...	...	.82
	3	...	.30	.75
	4	...	...	.76
	5	...	...	.73
Mean		10.57	10.42	10.72

The surfaces of the plates were scoured clean.

The plates were arranged on chords of a circle with the gun pivot as the centre, and the muzzle of the gun 28 feet distant from the centre of the plate toward which it was pointed, the

axis of the gun being then normal to the surface of each plate.

The gun was a 6-inch B. L. R., Mark III., 35 calibers long, mounted on a service centre-pivot carriage. The charge used was $44\frac{1}{2}$ lbs. for each round; brown prismatic powder manufactured by Messrs. Dupont. The striking velocity was 2075 feet per second.

The projectiles were all Holtzer 6-inch Armor-piercing Shell, with ogival of 2 calibers radius, and were brought up to the standard weight of 100 lbs. by filling them with sand and fragments of iron. These fragments of iron weighed about 2 oz. each.

The gun was mounted on a heavy wooden platform protected by a structure of timber roofed with iron plates and a pile of sand-bags in front, through which the muzzle projected.

The pointing was done by means of central cross-hair sights in the axis of the bore.

Bomb-proofs had been erected at convenient places on the grounds. The one nearest the gun, at a distance of 50 feet, protected the firing party. The gun was fired by means of friction primer and a long lanyard.

The Board caused photographs to be taken of each plate before and after each shot; of all three plates in a group after four shots each, and, also, after five shots each; of the recovered projectiles, and of such fragments of plate as could be identified.

At 11 A. M. the Board began the firing trial.

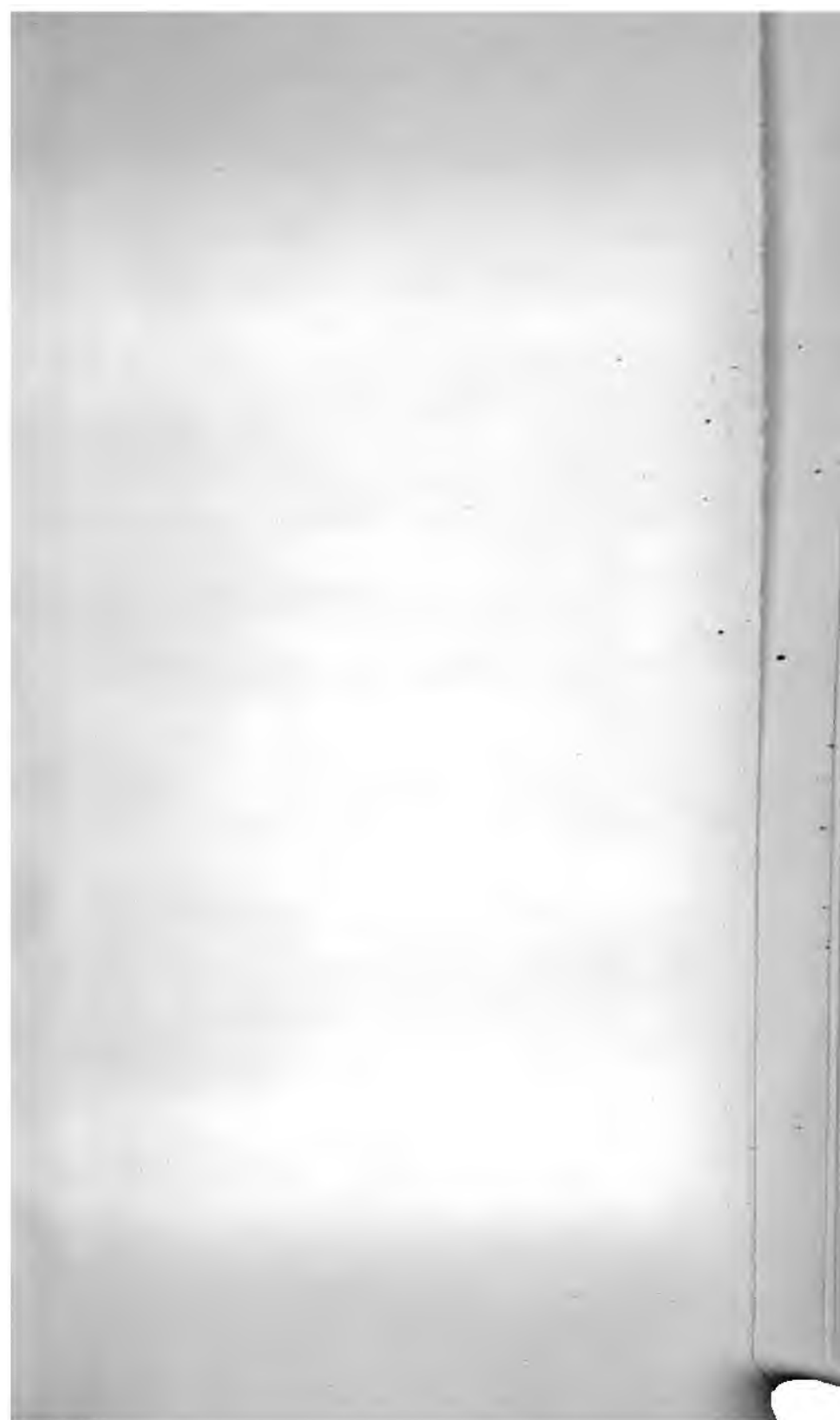
ROUND I.

1ST SHOT AT THE STEEL PLATE.

Gun,	6" B. L. R.	Elevation, — $2^{\circ} 50'$.
Projectile,	Holtzer A.-P. Shell,	Striking velocity,
	100 lbs.	2075 f. s.
Charge,	$44\frac{1}{2}$ lbs. brown prism.	Striking energy,
		2988 ft.-tons.

The point of impact was 24 ins. from the bottom and 24 ins. from the right-hand edge of the plate. The projectile entered





The point of impact was 24 ins. from the left-hand edge and 24 ins. from the bottom of the plate. The projectile penetrated to a depth of 12 inches and rebounded entire to a distance of 26 feet to the front and 3 feet to the right. It was shortened 0.10 in. A front bulge was raised, 18.5 ins. diameter and 1 in. high, with a well-developed fringe projecting 0.75 in. Seven short radial cracks were developed in the bulge, two of them being connected by two short surface hair cracks. One small piece of fringe scaled off. The shot-hole was regular with a smooth surface, and showing star-shaped cracks at inner extremity.

The side plates were uninjured. Two bolts were started. One nut of a side plate bolt was broken off. The backing was undisturbed.

(Photographs Nos. 7 and 17.)

ROUND 5.

2D SHOT AT THE COMPOUND PLATE.

Gun,	6" B. L. R.	Elevation, — 2° 50'.
Projectile,	Holtzer A.-P. Shell,	Striking velocity,
	100 lbs.	2075 f. s.
Charge,	44½ lbs. brown prism.	Striking energy,
		2988 ft.-tons.

The point of impact was 24 ins. from the left-hand edge and



0.6 in. to 1.8 ins. Where this crack reached the right edge of the plate, the steel face showed a vertical curved fracture of a minimum thickness of 0.3 in. and separated 1.9 ins. at the top.

The interior surface of the shot-hole was rough and broken, showing a disintegration of the metal, many small loose fragments of which were lying in the hole. The cracks developed by the preceding shot were all increased in size, the lower part of the plate being much racked.

The side plates were uninjured. Two bolts were slightly started.

The backing showed but slight set-back. One tie-bolt in backing nearest impact was driven 4 ins. to the rear. The rear side of bolt heads of first vertical row were started 0.10 in. from the braces.

(Photograph No. 8.)

ROUND 6.

2D SHOT AT THE NICKEL STEEL PLATE.

Gun,	6" B. L. R.	Elevation, — 2° 50'.
Projectile,	Holtzer A.-P. Shell,	Striking velocity,
	100 lbs.	2075 f. s.
Charge,	44½ lbs. brown prism.	Striking energy,
		2988 ft.-tons.

The point of impact was 24 ins. from the left-hand edge and 24 ins. from the bottom of the plate. The projectile penetrated and remained in the plate apparently intact, its base projecting 1.6 ins. The rotating band was still in place, but sheared flush with the body of the shell.

A front bulge was thrown up, 16 ins. in diameter and 1.10 ins. high. A piece was scaled off for about two-thirds the circumference of the bulge, of an average diameter of 12.55 ins. and average depth of 1.10 ins.

The side plates were uninjured, two bolts slightly started. The backing was uninjured. The tie-bolt nearest the point of impact was driven 12 ins. to the rear.

(Photograph No. 9.)

ROUND 7.

3D SHOT AT THE STEEL PLATE.

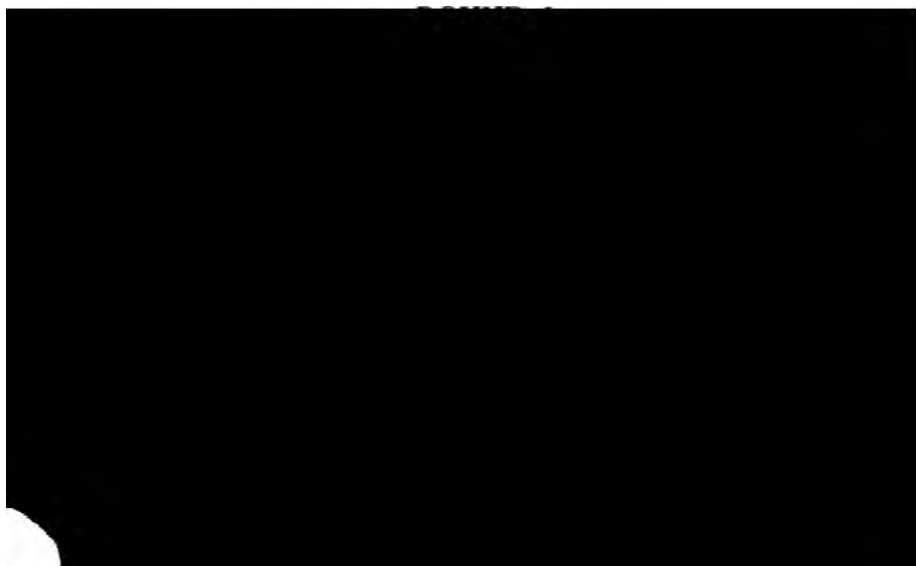
Gun,	6" B. L. R.	Elevation, — 2° 50'.
Projectile,	Holtzer A.-P. Shell,	Striking velocity,
	100 lbs.	2075 f. s.
Charge,	44½ lbs. brown prism.	Striking energy,
		2988 ft.-tons.

The point of impact was 24 ins. from the right-hand edge and 24 ins. from the top of the plate. The projectile penetrated to a depth of 12.5 ins. and rebounded entire to a distance of 30 ft. It was shortened 0.14 in., and the diameter of the bourrelet was increased 0.01 in.

A front bulge was found, 18.5 ins. in diameter and 1 in. high, with a well-developed fringe projecting 1 in. Five short radial surface cracks were developed in the bulge, and two small pieces of the fringe were scaled off. The shot-hole was smooth and regular, showing star-shaped cracks at its inner extremity.

The side plates were uninjured, one piece of bolt 7 ins. long was broken off and thrown out to the front. The backing and its bolts were undisturbed.

(Photographs Nos. 10 and 17.)



Ten deep radial cracks were produced, some of them being connected by cross-cracks. A large piece of steel face in upper right-hand corner was slightly separated from the wrought iron back, and a smaller piece was in the same condition below the shot-hole.

Old cracks in lower part of plate were increased in size, and the face of the plate was quite shattered.

The interior surface of the shot-hole was rough and broken, showing disintegration of the surrounding metal, many small fragments of which had been shaken off and were lying in the hole.

The side plates were not injured. The nuts of five bolts in the left side plate were unscrewed from 0.25 in. to 0.50 in.

The backing was uninjured.

(Photograph No. 11.)

ROUND 9.

3D SHOT AT THE NICKEL STEEL PLATE.

Gun,	6" B. L. R	Elevation, 2° 50'.
Projectile,	Holtzer A.-P. Shell,	Striking velocity,
	100 lbs.	2075 f. s.
Charge,	44½ lbs. brown prism.	Striking energy,
		2988 ft.-tons.

The point of impact was 24 ins. from the right-hand edge and 24 ins. from the top of the plate. The projectile penetrated and remained in the plate apparently intact, its base projecting 4.5 ins., and its rotating band half torn off. A front bulge was raised, 18 ins. in diameter and 1.5 ins. high.

Two very short radial surface cracks were produced in the bulge. Two small pieces scaled out of bulge. The side plates were uninjured; the bolt heads were slightly bent.

The backing was undisturbed, and no bolts were started.

(Photograph No. 12.)

ROUND 10.

4TH SHOT AT THE STEEL PLATE.

Gun,	6" B. L. R.	Elevation, 2° 50'.
Projectile,	Holtzer A.-P. Shell,	Striking velocity,
	100 lbs.	2075 f. s.
Charge,	44½ lbs. brown prism.	Striking energy,
		2988 ft.-tons.

The point of impact was 24 ins. from the left-hand edge and 24 ins. from the top of the plate. The projectile penetrated to a depth of 12.5 inches and rebounded, breaking into three large and several small pieces. The head was entire, the body in halves, the transverse break at 7 ins. from the base of shell.

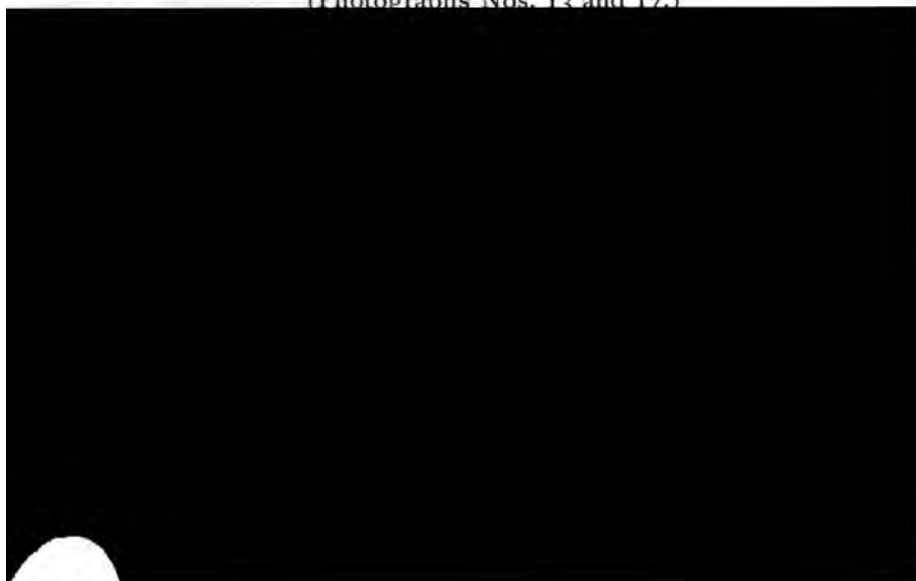
A front bulge was raised, 17 ins. in diameter and 1 in. high, with a well-developed fringe projecting 1 in.

Six short radial surface cracks were produced in the bulge, and one small piece of the fringe was scaled off. The surface of shot-hole was smooth and regular, showing star-shaped cracks at its inner extremity.

The side plates were uninjured.

The backing was undisturbed. One bolt, broken by previous shot, was driven to the rear 2 ins.

(Photographs Nos. 13 and 17.)



and backing, breaking into three large and several small pieces. The largest piece passed over the earth backing, and lodged in the butt 60 feet away.

Three deep cracks were developed below shot-hole. All the steel face above this and the preceding shot-hole separated from the wrought-iron back, and the greater part of it was thrown off in seven large, and many small fragments, the larger fragments weighing, respectively, 29, 58, 92, 125, 157, 178, and 380 lbs.

A part of the steel face below the preceding shot-hole separated from the wrought-iron back and was thrown off.

All previous cracks widened.

That part of the wrought-iron back which was exposed on the upper part of the plate showed a rough, broken appearance and contained three narrow cracks. The shot-hole was very rough on the interior surface, showing much disintegration of the metal, with small fragments of which it was nearly filled.

The remainder of the plate was badly racked, and showed 17 large cracks through steel face. The side plates were uninjured.

There was an irregular hole torn in the backing by the shot. No bolts were started.

(Photographs Nos. 14, 16, and 17.)

ROUND 12.

4TH SHOT AT THE NICKEL STEEL PLATE.

Gun,	6" B. L. R.	Elevation, 2° 50'.
Projectile,	Holtzer A.-P. Shell,	Striking velocity,
	100 lbs.	2075 f. s.
Charge,	44½ lbs. brown prism.	Striking energy,
		2988 ft.-tons.

The point of impact was 24 ins. from the left-hand edge and 24 ins. from the top of the plate. The projectile broke 3.5 ins. from face of plate, and 6.5 ins. from its base, its head r-

There were no cracks visible on the plate.

The side plates were uninjured, and no bolts were started.

The front timber of the backing, in the line of the shot-hole, was apparently broken in two.

The fragments of projectile that were recovered are shown in the photograph.

(Photographs Nos. 20, 22, and 23).

ROUND 15.

5TH SHOT AT THE COMPOUND PLATE.

Gun,	8" B. L. R.	Elevation, 0° 00'.
Projectile,	Firth A.-P. Shell,	Striking velocity,
	210 lbs.	1850 f. s.
Charge,	85 lbs. brown prism.	Striking energy, 4988 ft.-tons.

The point of impact was the centre of the plate. The projectile perforated the plate and backing, and disintegrated much of the metal about the hole. Most of the front plate was scaled off in 24 large and a great number of small pieces, the larger pieces varying in thickness from 3.75 to 5.50 ins.

Parts of the plate were left complete along each edge, as shown in the photographs, but much of it separated, some of



backing about 15 ft. It was shortened 0.24 in., and the diameter of the bourrelet was increased 0.015 in.

(Photographs Nos. 21, 22, and 23.)

The Board then adjourned until the plates could be removed from the backing so as to expose to view their rear faces.

The Board met at the Naval Ordnance Proving Ground on October 10, 1890, and examined the backs of the plates and the fronts of the backing, with the following results:

BACK OF STEEL PLATE.

(Photographs Nos. 24 and 24a.)

- No. 1 Shot. Back bulge 3.5 ins. high and 16 ins. diameter.
- No. 2 Shot. Back bulge 3.0 ins. high and 15 ins. diameter.
- No. 3 Shot. Back bulge 2.6 ins. high and 16 ins. diameter, with a piece broken out.
- No. 4 Shot. Back bulge 2.6 ins. high and 15 ins. diameter.
- No. 5 Shot. Back bulge 6.25 ins. high and 22 ins. diameter, with two pieces broken out.

Diagonal cracks from front of plate all through to back.

BACKING OF STEEL PLATE.

(Photograph No. 25.)

- No. 1 Shot. Indented 2.75 ins.
- No. 2 Shot. Indented 2.40 ins.
- No. 3 Shot. Indented 2.00 ins., two pieces embedded in the backing.
- No. 4 Shot. Indented 2.40 ins.
- No. 5 Shot. Indented 5.25 ins., and one piece embedded in the hole.

BACK OF NICKEL STEEL PLATE.

(Photographs Nos. 26 and 26a.)

- No. 1 Shot. Back bulge 5 ins. high and 21 ins. diameter.
- No. 2 Shot. Back bulge 6 ins. high and 21 ins. diameter.
- No. 3 Shot. Back bulge 4 ins. high and 19 ins. diameter.
- No. 4 Shot. Back bulge 4 ins. high and 18 ins. diameter.
- No. 5 Shot. A crater in back of plate was formed, of an average depth of 3.5 ins. and 21 ins. diameter.

BACKING OF NICKEL STEEL PLATE.

(Photograph No. 27.)

- No. 1 Shot. Indented 5.25 ins.
No. 2 Shot. Indented 4.75 ins.
No. 3 Shot. Indented 3.50 ins.
No. 4 Shot. Indented 3.50 ins.
No. 5 Shot. A hole $10\frac{1}{2}$ ins. deep in the wood, and 6 ins. deep to a fragment of metal left in the backing from the crater in the plate.

BACK OF COMPOUND PLATE.

(Photographs Nos. 28 and 28a.)

- No. 1 Shot. Back bulge 6.4 ins. high and 20.5 ins. diameter.
No. 2 Shot. Back bulge 6.25 ins. high and 18 ins. diameter.
No. 3 Shot. Back bulge 6 ins. high and 20 ins. diameter.
No. 4 Shot. Back bulge 7.25 ins. high and 19 ins. diameter, a large piece of plate broken out.
No. 5 Shot. Back bulge 7.5 ins. high and 21 ins. diameter, a piece of plate broken out.

BACKING OF COMPOUND PLATE.

(Photograph No. 29.)

- No. 1 Shot. Base of projectile 11 ins. in from face of backing.
No. 2 Shot. Base of projectile 4.75 ins. in from face of backing.
No. 3 Shot. Base of projectile 13.1 ins. in from face of backing.
- 

SUMMARY.

The Compound Plate was perforated by all projectiles, and its steel face was destroyed. Two of the shells passed completely through both plate and backing.

Both Steel Plates kept out all projectiles, the All-Steel Plate showing slightly greater resistance than the Nickel Steel Plate, but the former was badly cracked by the 8-inch shell, while the latter remained uncracked. The Board, therefore, places the three plates tested in the following order of "relative merit:"

1. Nickel Steel.
2. All Steel.
3. Compound.

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No. 1. STEEL PLATE BEFORE FIRING.

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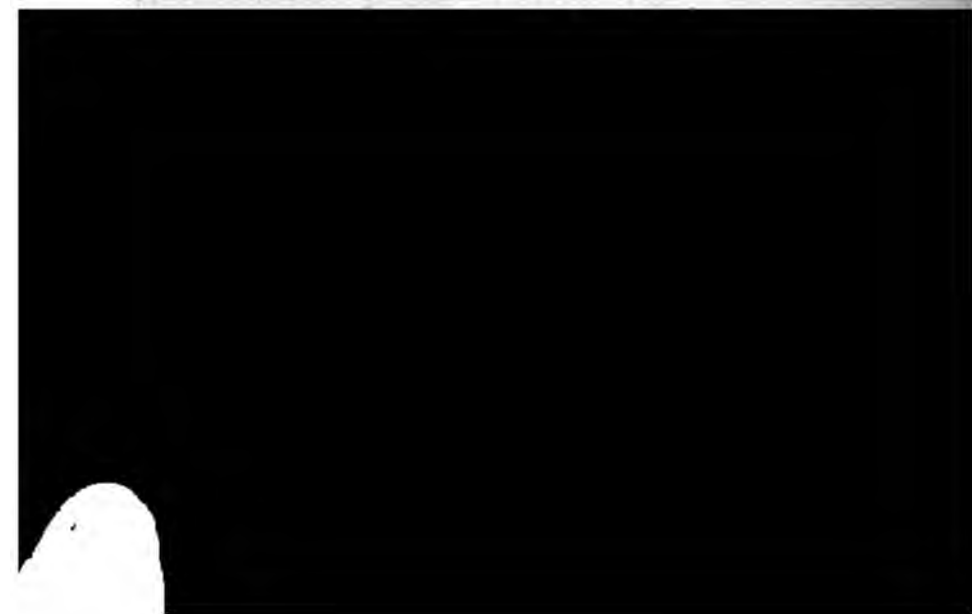


No. 2. COMPOUND PLATE BEFORE FIRING.
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No. 3. NICKEL-STEEL PLATE BEFORE FIRING.
(SCHNEIDER ET CIE.)





No. 4. STEEL PLATE AFTER FIRST SHOT.

(SCHNEIDER ET CIE.)





No. 5. COMPOUND PLATE AFTER FIRST SHOT.
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No. 4. STEEL PLATE AFTER FIRST SHOT.
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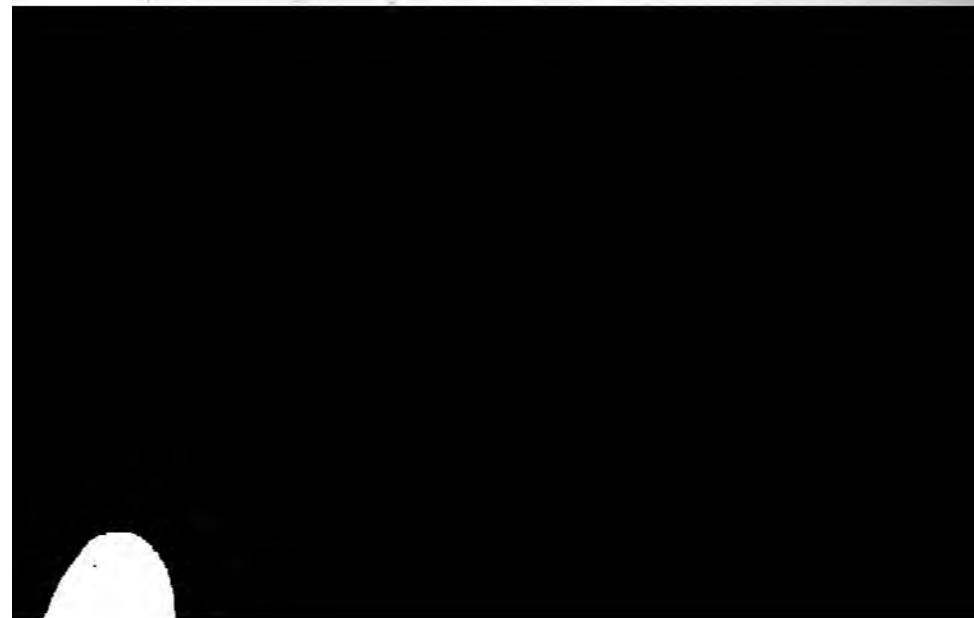
No. 5. COMPOUND PLATE AFTER FIRST SHOT.
(CAMMELL & Co.)





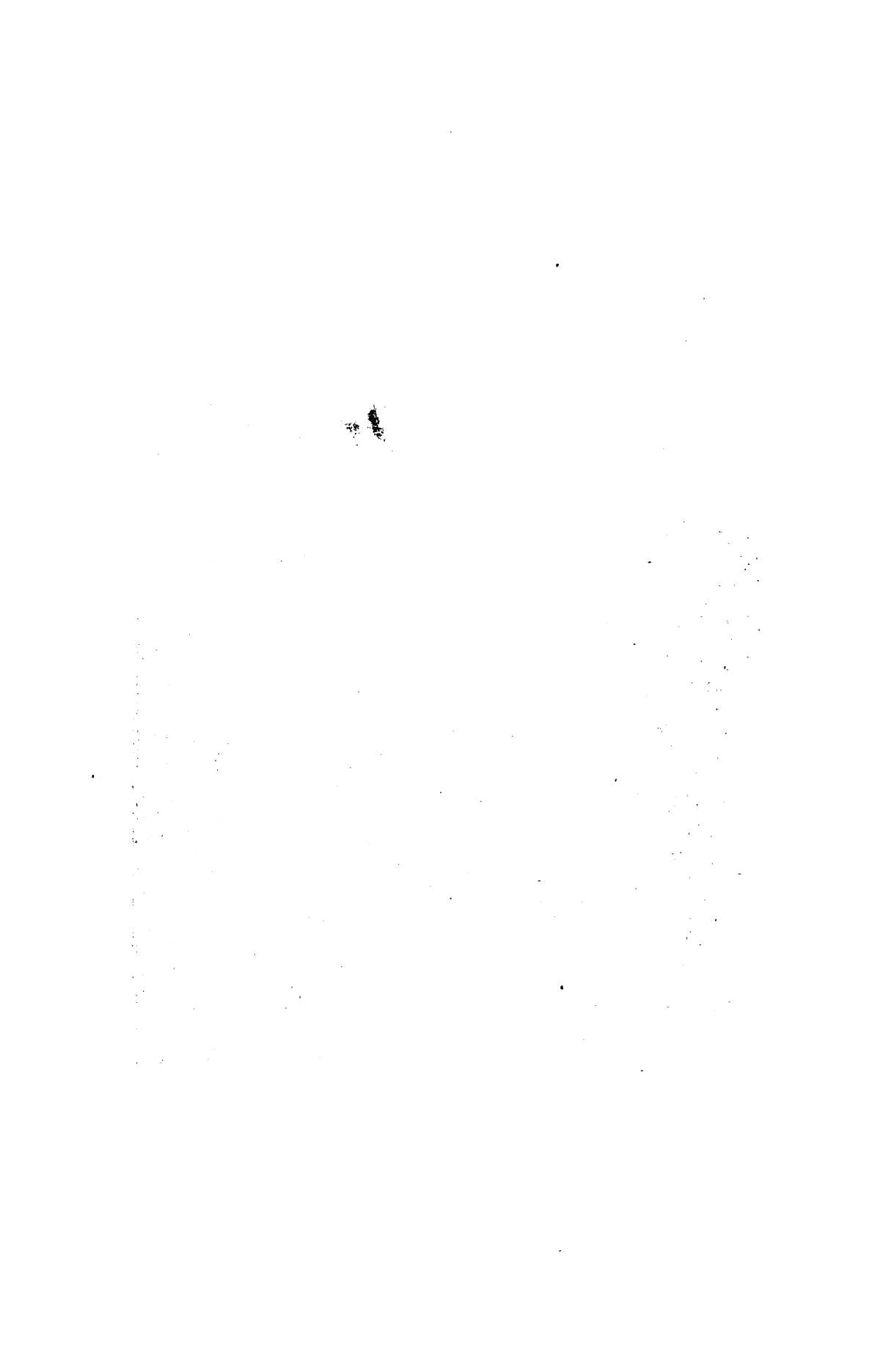
No. 6. NICKEL-STEEL PLATE AFTER FIRST SHOT.

(SCHNEIDER ET CIE.)





No. 7. STEEL PLATE AFTER SECOND SHOT.
(SCHNEIDER ET CIE.)

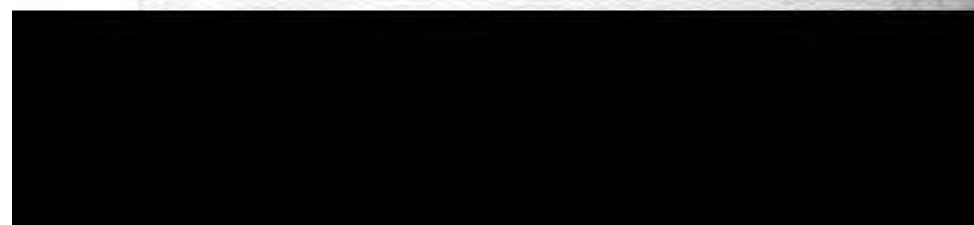
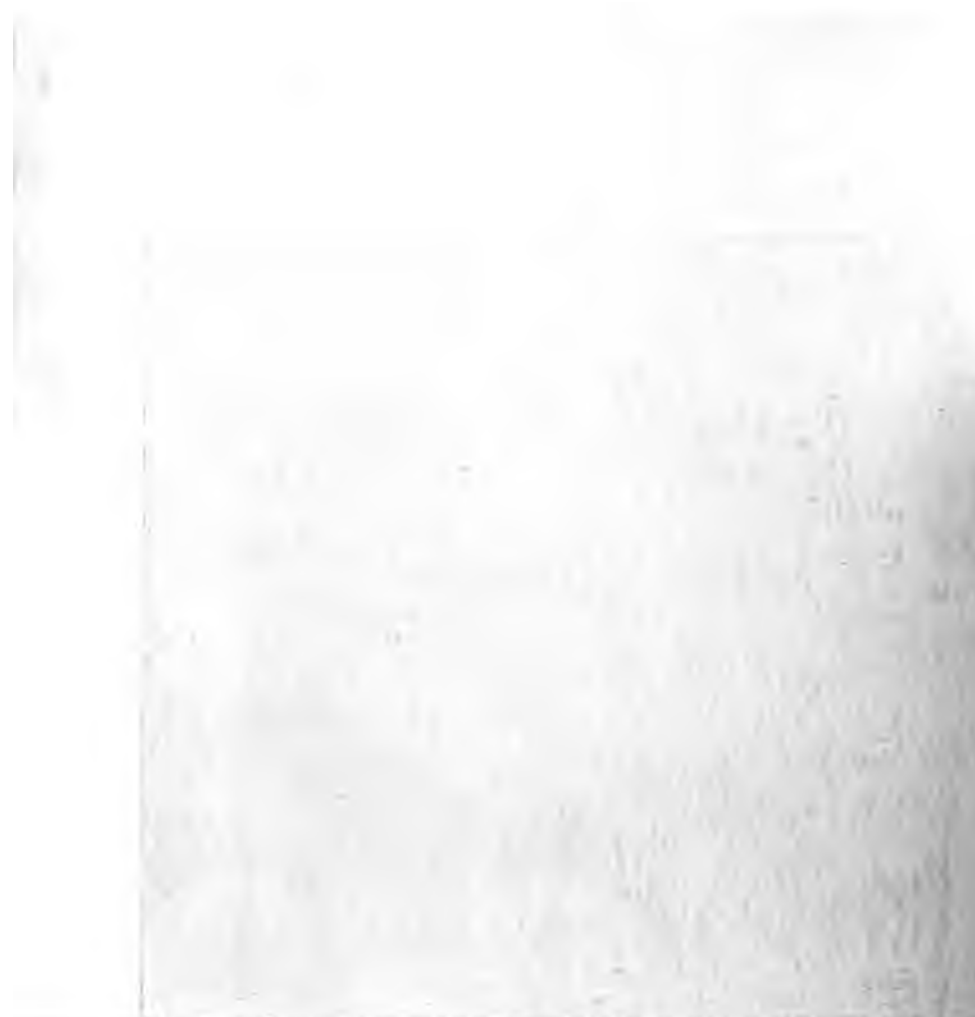




No. 8. COMPOUND PLATE AFTER SECOND SHOT.
(CAMMELL & Co.)



No. 9. NICKEL-STEEL PLATE AFTER SECOND SHOT.
(SCHNEIDER ET CIE.)





No. 11. COMPOUND PLATE AFTER THIRD SHOT.
(CAMMELL & Co.)





NO. II. COMPOUND PLATE AFTER THIRD SHOT.
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NO. 12. NICKEL-STEEL PLATE AFTER THIRD SHOT.
(SCHNEIDER ET CIE.)





No. 13. STEEL PLATE AFTER FOURTH SHOT.
(SCHNEIDER ET CIE.)





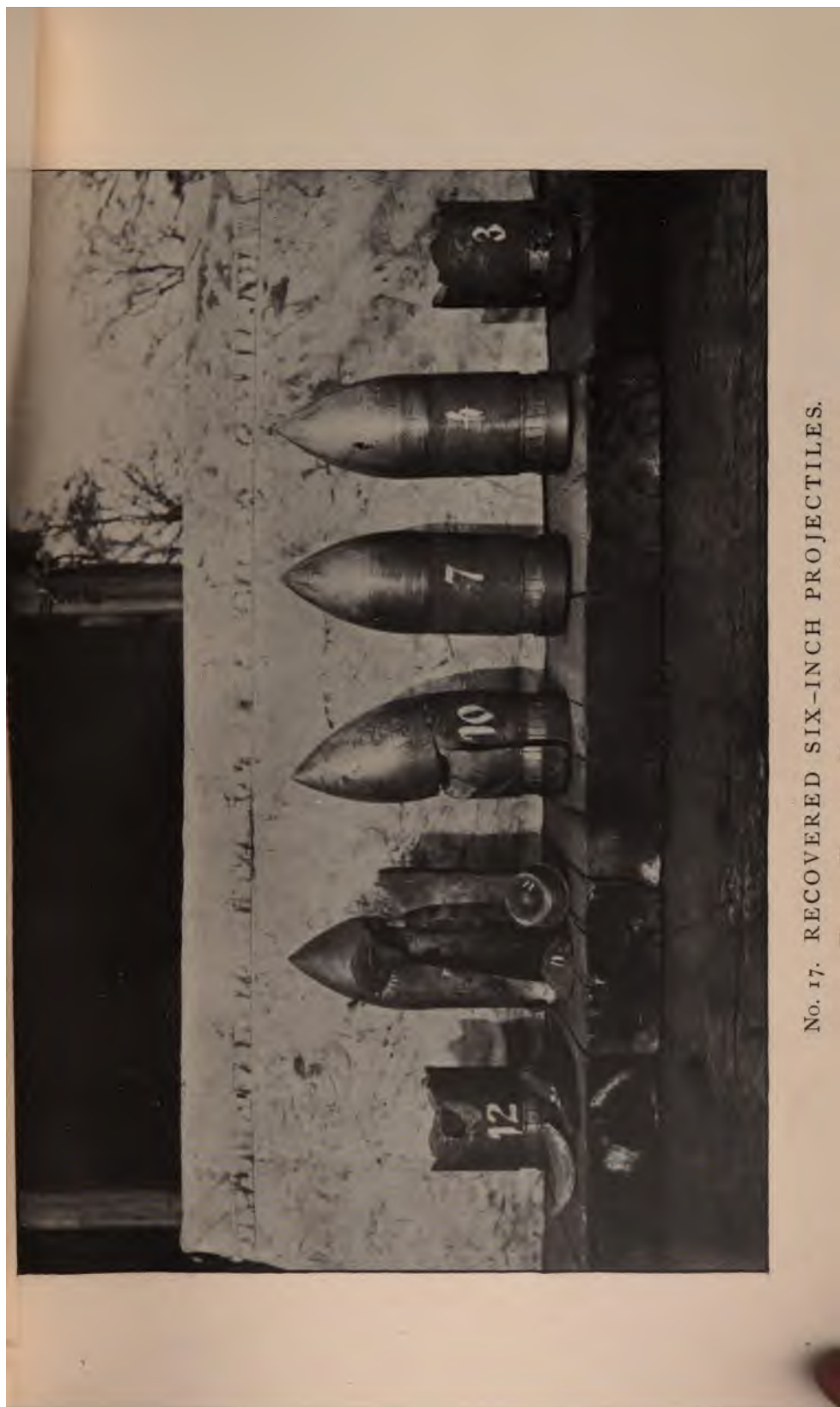
No. 14. COMPOUND PLATE AFTER FOURTH SHOT.
(CAMMELL & Co.)

No. 15. NICKEL-STEEL PLATE AFTER FOURTH SHOT.
(SCHNEIDER ET CIE.)



No. 17. RECOVERED SIX-INCH PROJECTILES.



No. 17. RECOVERED SIX-INCH PROJECTILES.

FIGURES REFER TO SERIAL NUMBER OF ROUNDS.





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NO. 18. VIEW OF PLATES AFTER FOUR SHOTS EACH.





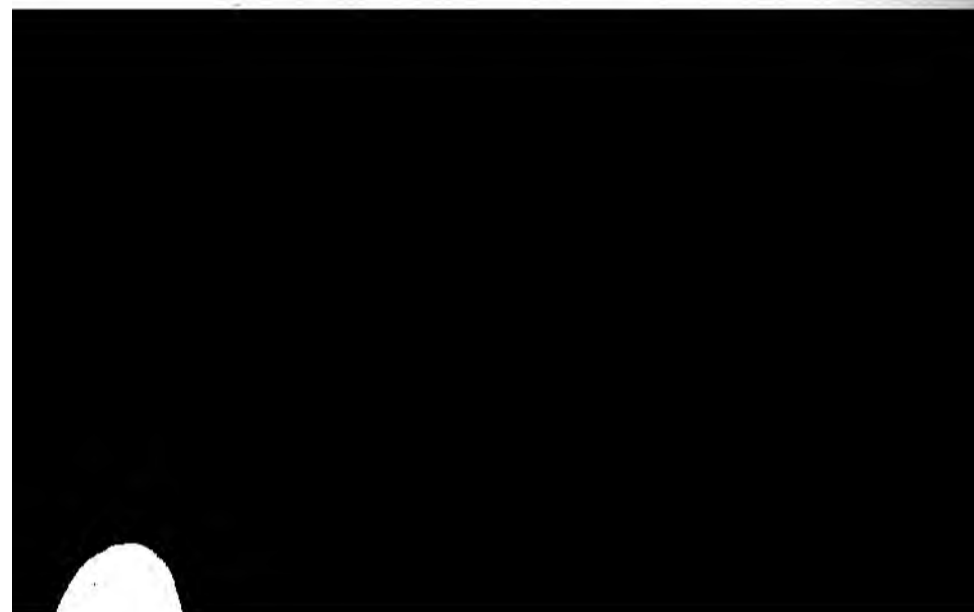
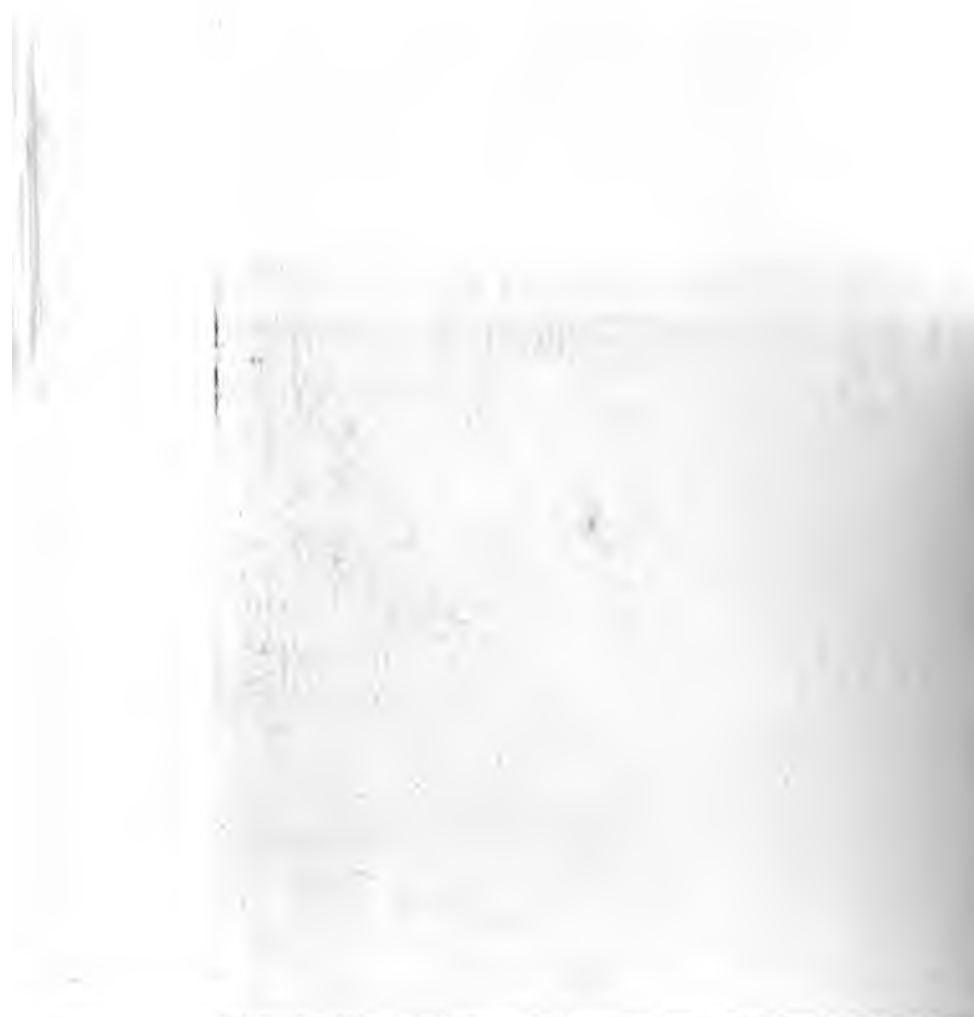
No. 20. NICKEL-STEEL PLATE AFTER FIFTH SHOT.

(SCHNEIDER ET CIE.)



No. 20. NICKEL-STEEL PLATE AFTER FIFTH SHOT.

(SCHNEIDER ET CIE.)





No. 21. COMPOUND PLATE AFTER FIFTH SHOT.

(Continued on p. 22)



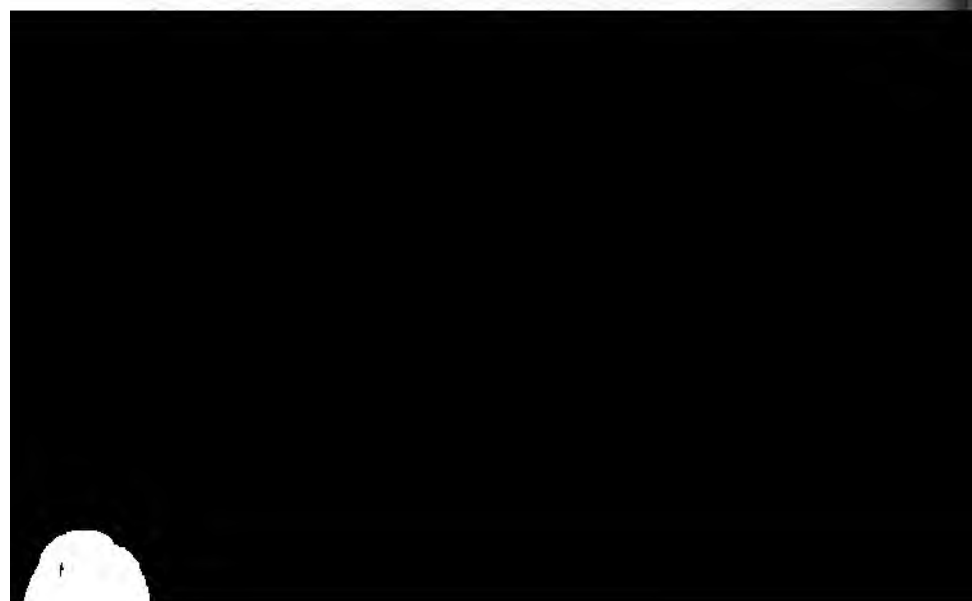
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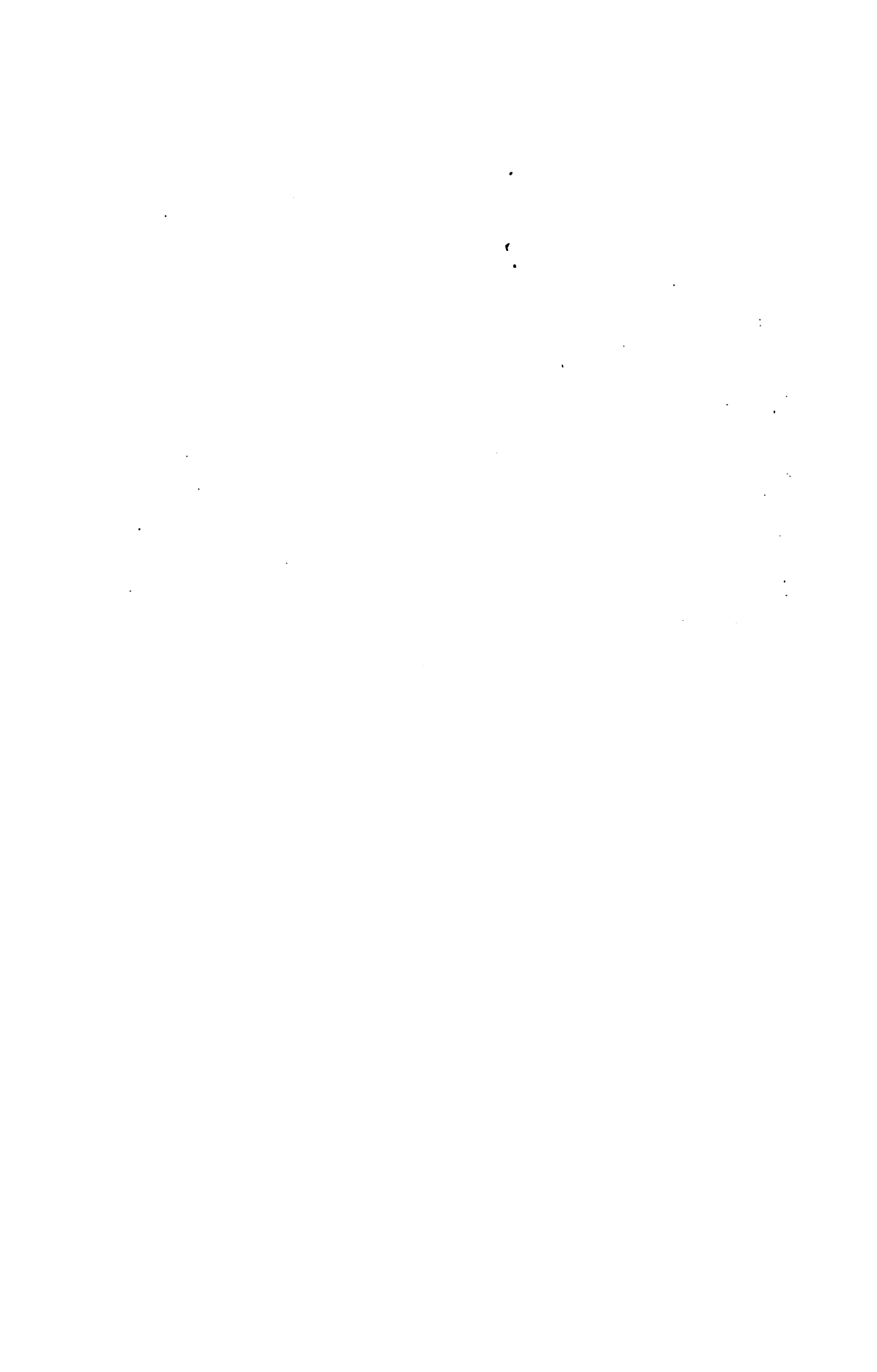
No. 22. VIEW OF PLATES AFTER FIVE SHOTS EACH.

FRAGMENTS OF COMPOUND PLATE IN POSITION IN WHICH THEY FELL.





FIRE AT STEEL PLATE. FIRE AT COMPOUND PLATE. FIRE AT NICKEL-STEEL PLATE.
No. 23. RECOVERED EIGHT-INCH PROJECTILES.





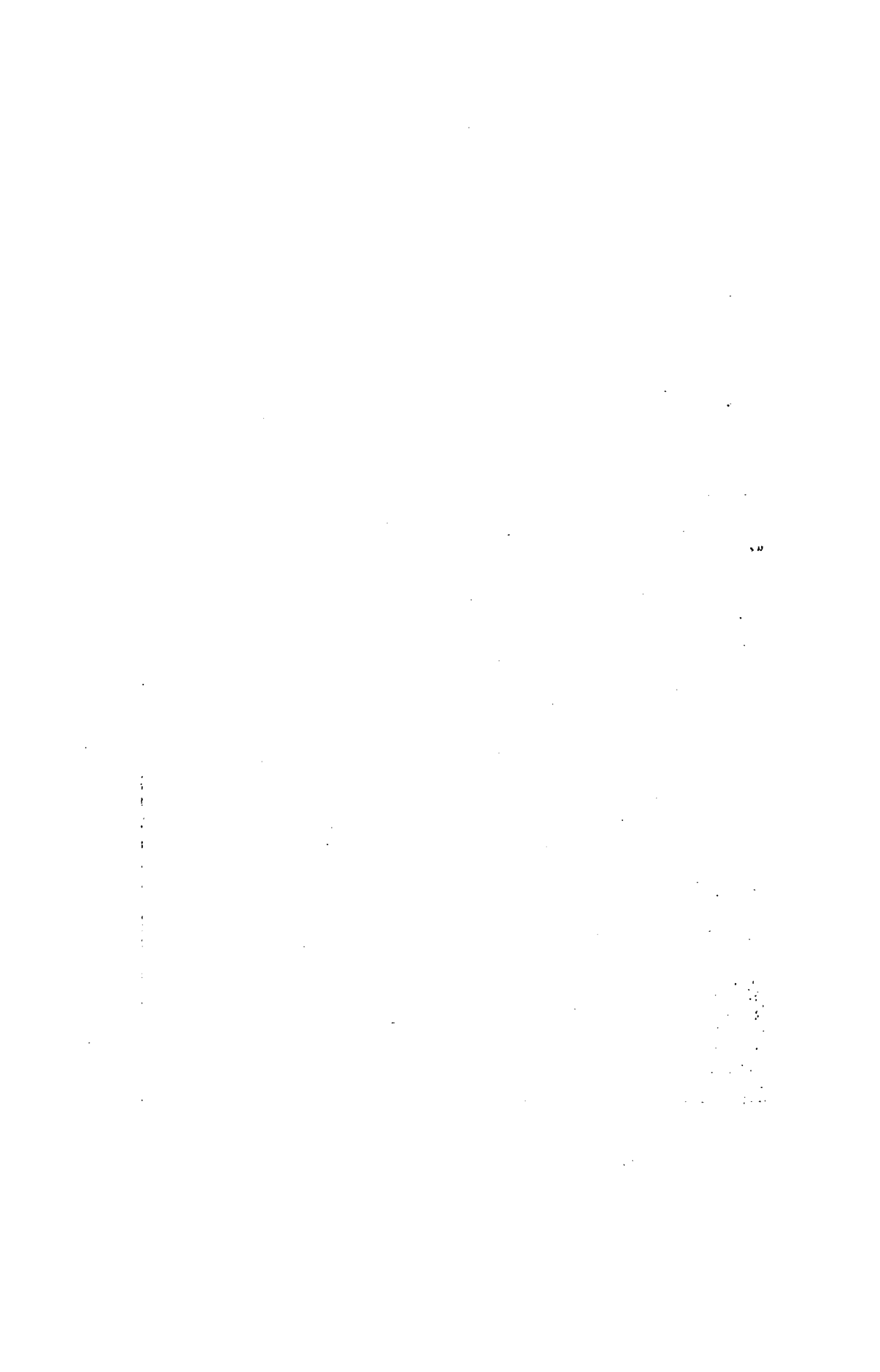
No. 24. BACK OF STEEL PLATE.
(SCHNEIDER ET CIE.)



No. 24a. BACK OF STEEL PLATE.
(SCHNEIDER ET C^{IE}.)



No. 25. BACKING OF STEEL PLATE.





NO. 26. BACK OF NICKEL-STEEL PLATE.
(SCHNEIDER ET CIE.)





No. 26a. BACK OF NICKEL-STEEL PLATE.

(SCHNEIDER ET CIE.)



No. 27. BACKING OF NICKEL-STEEL PLATE.



No. 28. BACK OF COMPOUND PLATE.

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No. 28a. BACK OF COMPOUND PLATE.

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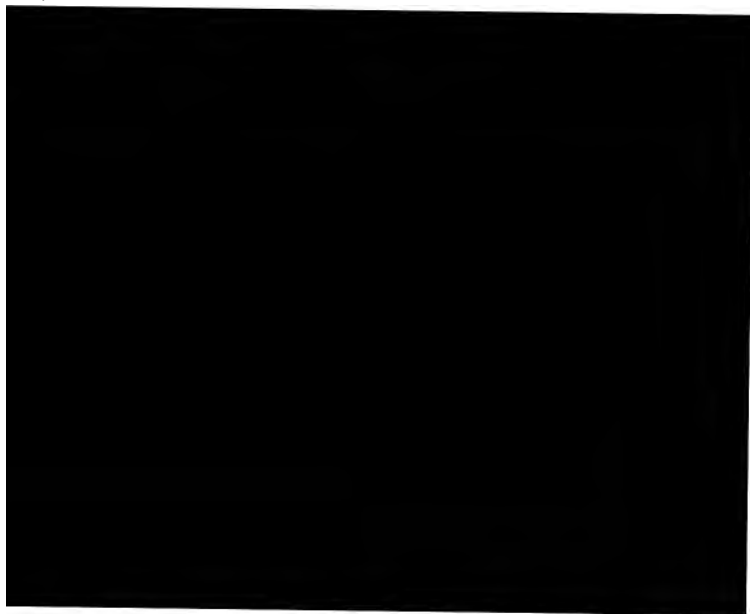
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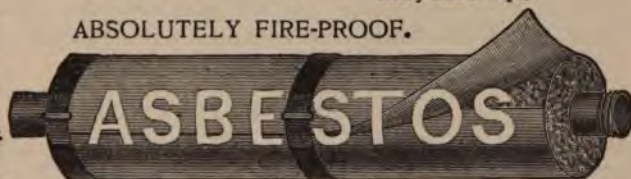
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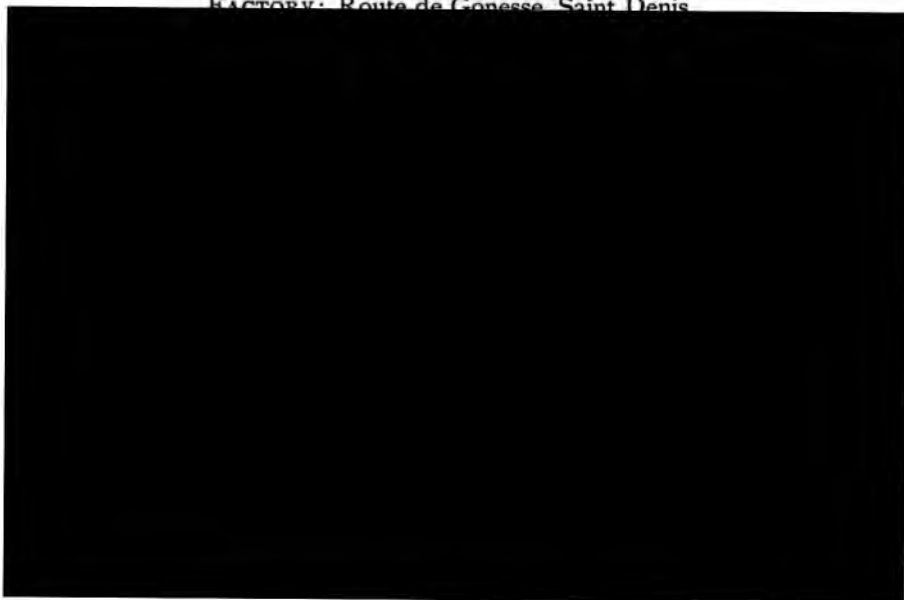
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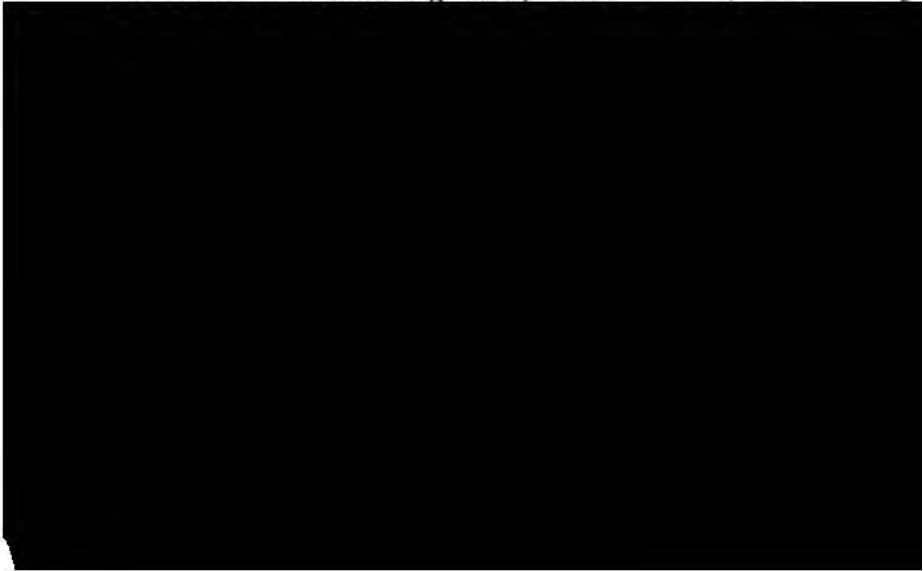
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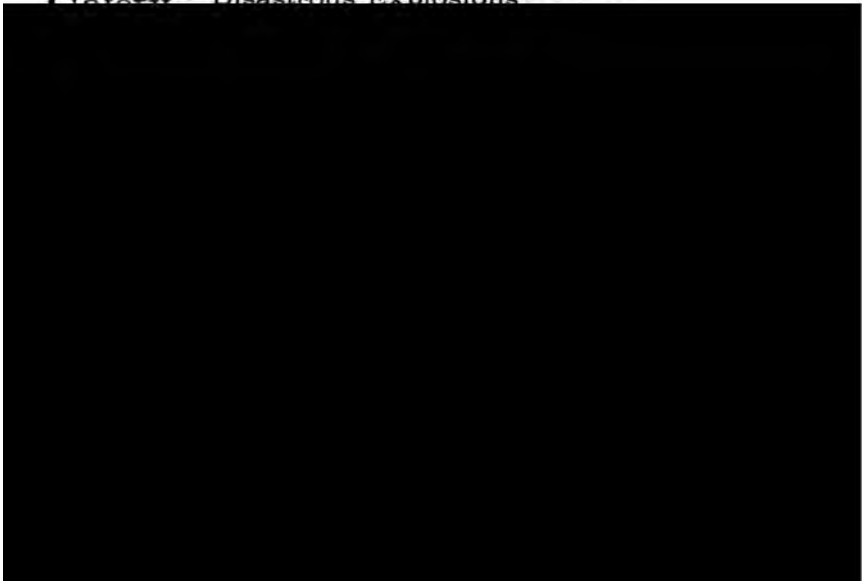
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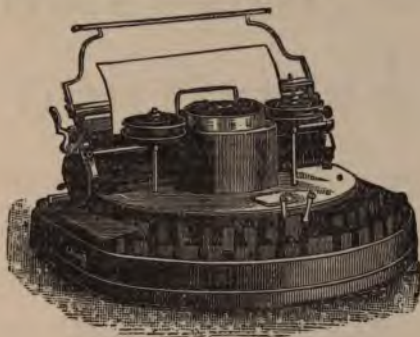
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ARTICLE VII.

SEC. 1. The Institute shall consist of regular, life, honorary, and associate members.

SEC. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

SEC. 3. The Prize Essayist of each year shall be a life member without payment of fee.

SEC. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex-officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

SEC. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

SEC. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

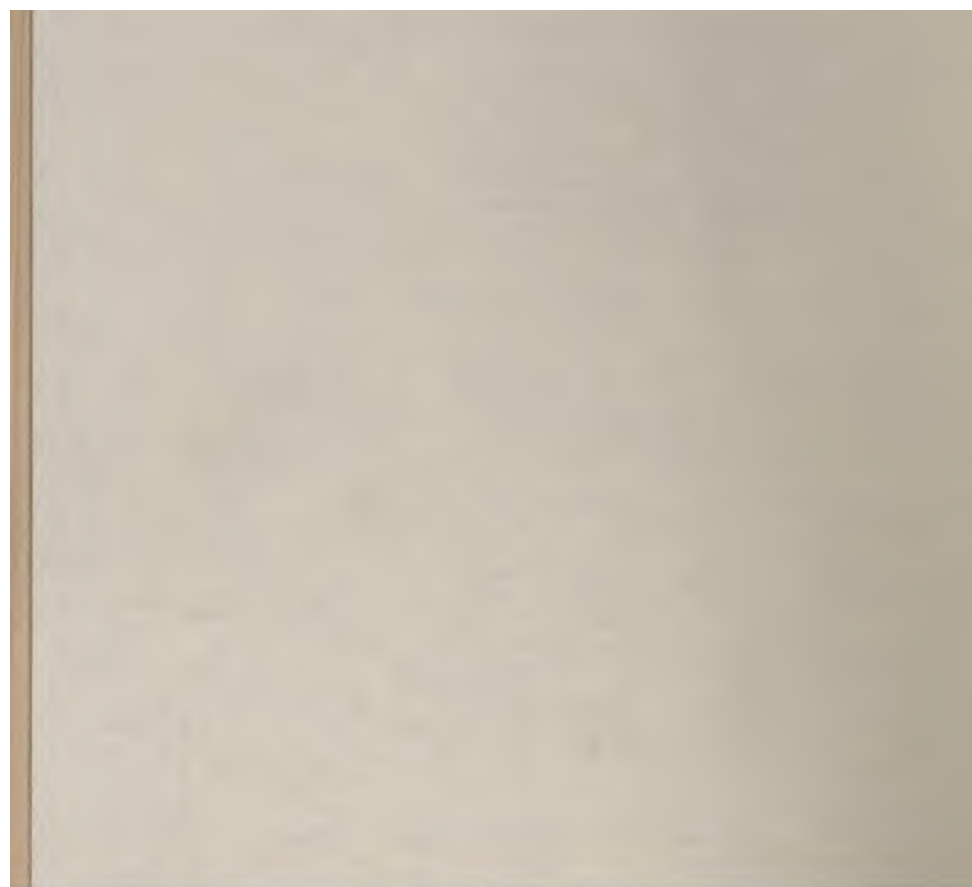
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